इंटरनेट मानक

Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

"जानने का अधिकार, जीने का अधिकार"
Mazdoor Kisan Shakti Sangathan
"The Right to Information, The Right to Live"

"पुराने को छोड नये के तरफ"
Jawaharlal Nehru
"Step Out From the Old to the New"

SP 43 (1987): Handbook on Structures with Reinforced Concrete Portal Frames (Without Cranes) [CED 38: Special Structures]

"ज्ञान से एक नये भारत का निर्माण"
Satyanarayan Gangaram Pitroda
"Invent a New India Using Knowledge"

Act Number 22 of 2005
The Indian Parliament
RIGHT TO INFORMATION

Made Available By
Public.Resource.Org

"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

BLANK PAGE

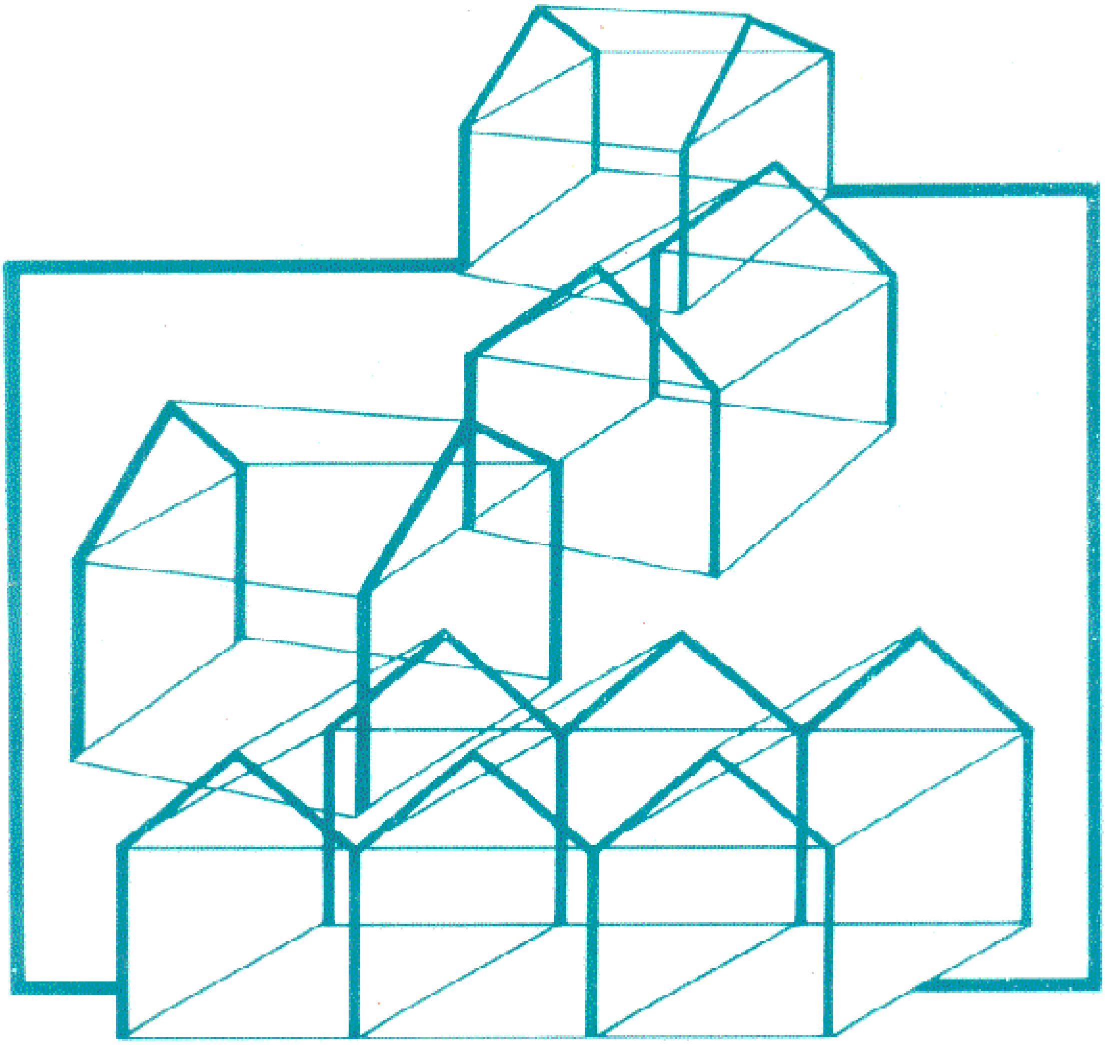
BRUTUM FULMEN

IGNORANTIA JURIS NON EXCUSAT

PROTECTED BY COPYRIGHT

HANDBOOK ON STRUCTURES WITH REINFORCED CONCRETE PORTAL FRAMES
(WITHOUT CRANES)

SP 43 (S&T) : 1987



BUREAU OF INDIAN STANDARD

HANDBOOK ON STRUCTURES WITH REINFORCED CONCRETE PORTAL FRAMES (WITHOUT CRANES)

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

SP 43 (S & T) : 1987

FIRST PUBLISHED JANUARY 1990

© BUREAU OF INDIAN STANDARDS

UDC 624·012·45 (021)

ISBN 81-7061-025-7

PRICE Rs 380.00

PRINTED IN INDIA
AT BENGAL OFFSET WORKS, 335 KHAJOOR ROAD, KAROL BAGH, NEW DELHI 110 005
AND PUBLISHED BY
BUREAU OF INDIAN STANDARDS, NEW DELHI 110 002

SPECIAL COMMITTEE FOR IMPLEMENTATION OF SCIENCE AND TECHNOLOGY PROJECTS (SCIP)

Chairman

DR H. C. VISVESVARAYA
Chairman & Director General
National Council for Cement and Building Materials
New Delhi

Members	*Representing*
SHRI V. RAO AIYANGARI	Department of Science & Technology, New Delhi
SHRI A. K. BANERJEE	Metallurgical and Engineering Consultants (India) Ltd, Ranchi
SHRI J. D. CHATURVEDI	Planning Commission, New Delhi
DIRECTOR	Central Building Research Institute (CSIR), Roorkee
SHRI GURNAM SINGH	Ministry of Food and Civil Supplies (Finance Division)
SHRI U. R. KURLEKAR	Ministry of Food and Civil Supplies
DR M. RAMAIAH	Structural Engineering Research Centre (CSIR), Madras
SHRI G. S. RAO SHRI A. CHAKRABORTY (*Alternate*)	Central Public Works Department, New Delhi
SHRI T. S. RATNAM SHRI P. K. KALRA (*Alternate*)	Bureau of Public Enterprises, New Delhi
SHRI G. RAMAN (*Member Secretary*)	Bureau of Indian Standards, New Delhi

WORKING GROUP FOR PROJECT B-8

Members	*Representing*
SHRI A. K. BANERJEE	Metallurgical & Engineering Consultants (India) Ltd, Ranchi
SHRI D. S. DESAI	M. N. Dastur & Co Pvt Ltd, Calcutta
SHRI J. C. GANGULY	Braithwaite Burn & Jessop Construction Co Ltd, Calcutta
SHRI P. V. NAIK	Richardson & Cruddas Ltd, Bombay
DR M. RAMAIAH SHRI V. S. PARAMESWARAN (*Alternate*)	Structural Engineering Research Centre (CSIR), Madras
SHRI A. RAMAKRISHNA SHRI S. SUBRAMANIAM (*Alternate*)	Engineering Construction Corporation Ltd, Madras
SHRI G. S. RAO SHRI A. CHAKRABORTY (*Alternate*)	Central Public Works Department, New Delhi
DR P. SRINIVASA RAO PROF (DR) L. N. RAMAMURTHY (*Alternate*)	Indian Institute of Technology, Madras
SHRI T. S. RATNAM SHRI P. K. KALRA (*Alternate*)	Bureau of Public Enterprises, New Delhi
SHRI D. AJITHA SIMHA	Bureau of Indian Standards, New Delhi
SHRI C. N. SRINIVASAN	C. R. Narayana Rao Architects & Engineers, Madras
SHRI ASHOK TREHAN SHRI A. C. GUPTA (*Alternate*)	National Thermal Power Corporation Limited, New Delhi
DR H. C. VISVESVARAYA	National Council for Cement and Building Materials, New Delhi

FOREWORD

The Department of Science and Technology set up an Expert Group on Housing and Construction Technology in 1972. This Group carried out in depth studies in various areas of civil engineering and construction practices followed in the country. During the preparation of the Fifth Five-Year Plan in 1975, the Group was assigned the task of producing a Science and Technology Plan for research, development and extension work in the sector of housing and construction technology. As a result of this and on the recommendation of the Department of Science and Technology, the Planning Commission approved the following two projects which are assigned to the Bureau of Indian Standards (BIS):

a) *Project B-7* – Development Programme on Code Implementation for Building and Civil Engineering Construction; and

b) *Project B-8* – Typification of Industrial Structures.

BIS has set up a special committee (SCIP) consisting of experts to advise and monitor the execution of these projects. A Working Group under SCIP oversees the work of Project B-8.

In a developing country like India, the capital outlay under each Five-Year Plan towards setting up of industries and consequently construction of industrial buildings is very high. It is, therefore, necessary that the various parameters of industrial buildings be standardized on broad norms so that it will be feasible to easily adopt prefabricated members, particularly where repetitive structures could be used.

The standardization of parameters for industries by itself will be, no doubt, a difficult task as it will not be possible to specify the requirements of each industry. The layout including height will vary from industry to industry, for it depends on the process of manufacture and end products. However, a little more detailed analysis of the requirements indicated that the problems may not be as difficult as it appears. Although it would not be possible to specify any constraint on the parameters, a broad norm can be given within which most industries could be accommodated.

The object of the Project B-8 is to typify at national level the common forms of industrial structures used in light and medium engineering industries, warehouses, workshops and process industries, and to obtain economical designs under these conditions. Even if an industrial complex is classified as heavy industry, it need not necessarily mean that all the industrial structures coming within the complex should be heavy industrial structures and that many structures could be from the typified design.

The main objective of typification of industrial structures is to reduce the variety to the minimum and provide standard prefabricated designs so that the structures could be easily mass produced and made available to the user almost off the shelf. In doing so, there will be tremendous saving in time in putting up an industry into production and hence increased production. This would indirectly increase the overall economy to the country. This would also help in the orderly use of scarce materials like steel and cement. This would be of immense use to structural engineers as well, since it would relieve them to a large extent from the routine and repetitive calculations. Thus the engineer's time could be used to look at more innovative and economical alternatives.

The project on typification of industrial structures involved the following three main tasks prior to preparation of typified designs:

a) *Task I* – Survey and classification of industrial structures into different types;

b) *Task II* – Identification of industrial structures repeated a large number of times in the country, which are amenable for typification from the classified list prepared during task I; and

c) *Task III* – Specifying the elements of the industrial structures to be typified taking into consideration a number of parameters, such as structures with cranes and without cranes, span length, height, support conditions, slope of roof, wind and earthquake forces, spacing, field and shop connections, material (steel, reinforced concrete), etc.

The data regarding physical parameters like span, spacing, roof slope, column height, crane loading, etc, of existing structures has been obtained from several public sector enterprises through Bureau of Public Enterprises (BPE). Some information from private industries has also been collected by BIS.

The typified design for the following types of industrial structures in steel and reinforced concrete is envisaged to be brought out based on appropriate Indian Standards:

a) *Steel Structures*

1) Structures with steel roof trusses (with and without cranes)
2) Structures with steel kneebraced trusses (without cranes)
3) Structures with steel portal frames (without cranes)
4) Structures with steel portal frames (with cranes)
5) Structures with steel latice frames (without cranes)

b) *Reinforced Concrete Structures*

1) Structures with RCC roof trusses (with and without cranes)
2) Structures with RCC portal frames (without cranes)
3) Structures with RCC portal frames (with cranes)

In each case of structures with cranes, the maximum capacity of crane considered is limited to 20 tonnes, normal range in light industries.

This Handbook deals with typification of structures with RCC portal frames (without cranes). Typification includes analysis and design of RCC portal frames. The portal frame has been analyzed and designed for vertical and lateral loads (wind and earthquake forces) using the moment resisting portal frame action, with pinned and fixed support alternatives. Adequate wind bracing along the length of the building should be provided to withstand the wind on end gable and drag force on the roof and walls. Since the design for this depends upon the length of the building, locations of the expansion joint, etc, the typified design of these bracings is not given in the Handbook. However, an illustrative example of bracing design has been included.

Some of the points to be noted regarding analysis and design of these structures are as follows:

a) The typified designs have been given for the following parameters:

Span lengths (metres) = 9, 12, 18, 24 and 30
Spacing of frames (metres) = 6.0 and 12.0
Roof slopes = 1 in 3, 1 in 4 and 1 in 5

Span (m)	*Column Height* (m)	*No. of Bays*			
		1	2	3	4
9.0	5.0, 6.5	*	*	*	*
12.0	5.0, 6.5, 9.5	*	*	*	*
18.0	6.5, 9.5, 12.5	*	*	*	–
24.0	9.5, 12.5	*	*	–	–
30.0	9.5, 12.5	*	–	–	–

*Combination is available

Wind zones = I, II and III
Earthquake zones = I, II, III, IV and V
Type of support = Fixed and hinged

The column height specified above includes 0.5 m length of column which is embedded below ground level.

b) The analysis of portal frames has been made using a computer programme based on the stiffness method of analysis.

c) The internal pressure/suction specified in IS:875-1964 for buildings with normal permeability (±0.2) has been considered in design.

d) The structural design of RCC sections is based on IS:456-1978. Since the designs presented in the Handbook could be used either for a cast *in-situ* construction or for a precast construction, therefore M 25 concrete has been used for the design of all portal frames, and 6.0 m span RCC purlins and cladding runners. The 12.0 m span prestressed concrete purlins and cladding runners are designed using M 40 concrete.

e) For portal frames, of both fixed and hinged support, prismatic rafter sections are adopted. Prismatic column sections are adopted for portal frames with fixed support and non-prismatic column sections are adopted for portal frames with hinged base.

f) To facilitate prefabricated construction, the position of joints and the joint details have been included to illustrate the method of detailing. This should not be considered as the only available method for detailing.

g) The typified design results are given for purlins, cladding runners and frame members. Design of other elements, such as lugs to support the purlins, brackets to support cladding runners and eaves beams are also covered. Bracing and foundation designs have not been typified because of varying design parameters. However, a typical example of bracing design and footing design is included.

h) A detailed design example in the design office format is given in the Handbook illustrating the use of analysis and design information presented.

j) On the basis of typified designs for different spans, spacings, roof slopes, etc, some conclusions regarding the more economical designs is covered in the Handbook.

k) The Handbook is intended to be used by qualified engineers only.

This Handbook is based on the work done by Structural Engineering Laboratory, Department of Civil Engineering, Indian Institute of Technology (IIT), Madras. The draft handbook was circulated for review to Shri J. Durai Raj, New Delhi; University of Roorkee, Roorkee; National Projects Construction Corporation Limited, New Delhi; Engineer-in-Chief's Branch, Army Headquarters, New Delhi; Gammon India Limited, Bombay; Association of Consulting Engineers (India), New Delhi; Tata Consulting Engineers, Bombay; Metallurgical and Engineering Consultants (India) Limited, Ranchi; National Industrial Development Corporation Limited, New Delhi; Research Designs & Standards Organization, Lucknow; S. B. Joshi and Company Limited, Bombay; Food Corporation of India, New Delhi; Engineers India Limited, New Delhi; National Hydroelectric Power Corporation Limited, New Delhi; National Thermal Power Corporation, New Delhi; Western Railways, Bombay; Braithwaite and Company Limited, Calcutta; Tata Iron and Steel Company Limited, Jamshedpur; B.G. Shirke and Company, Pune; City and Industrial Development Corporation of Maharashtra Limited, Bombay; Stup Consultants Limited, Bombay; Bharat Heavy Electrical Limited, Ranipet; Housing and Urban Development Corporation Limited, New Delhi; Hindustan Steel Works Construction Limited, Calcutta; Hindustan Prefab Limited, New Delhi; Planning Commission, New Delhi; C.R. Narayana Rao Architects and Engineers, Madras; Engineering Construction Corporation Limited, Madras; Central Building Research

Institute (CSIR), Roorkee; Jessope & Company Limited, Calcutta; National Council for Cement and Building Materials, New Delhi; Structural Engineering Research Centre (CSIR), Madras; Bureau of Public Enterprises, New Delhi; Central Public Works Department (CDO), New Delhi; M.N.Dastur and Company Private Limited, Calcutta; Bokaro Steel Limited, Bokaro; Housing and Urban Development Corporation Limited, New Delhi; and the views received have been taken into consideration while finalizing the Handbook.

CONTENTS

Page

1. GENERAL 1

2. ANALYSIS 1

3. DESIGN 3

4. RESULTS OF PORTAL FRAMES : ANALYSIS AND DESIGN 4

5. MISCELLANEOUS 5

6. ILLUSTRATIVE DESIGN EXAMPLES 7

7. ESTIMATION OF QUANTITIES OF CONCRETE/STEEL 26

8. SUMMARY AND CONCLUSIONS 26

9. REFERENCES 27

10. TABLES 29

11. FIGURES 181

1. GENERAL

1.1 Introduction – Reinforced concrete portal frame is one of the structural systems that can be adopted for construction of industrial buildings. The resistance of vertical loads and to lateral loads (due to wind, earthquake, etc) in the transverse direction in such buildings is generally derived from the frame action, whereas the resistance to lateral loads in the longitudinal direction is provided by means of longitudinal column bracings in the end bays.

Industrial sheds using reinforced concrete portal frame as the main load carrying system may be with or without cranes. The Handbook gives information only about portal frames without cranes but subjected to dead load, live load and wind load/seismic load according to appropriate Indian Standards.

The analysis and design results are given for purlins, cladding runners and frames for the following parametres:

Span length (m) = 9.0, 12.0, 18.0, 24.0 and 30.0
Spacing of frames (m) = 6.0 and 12.0
Roof slopes = 1 in 3, 1 in 4, and 1 in 5
Roof covering = Asbestos cement sheet roofing

Span (m)	*Column Height* (m)	*Number of Bays* 1	2	3	4
9.0	5.0, 6.5	*	*	*	*
12.0	5.0, 6.5, 9.5	*	*	*	*
18.0	6.5, 9.5, 12.5	*	*	*	
24.0	9.5, 12.5	*	*	–	–
30.0	9.5, 12.5	*	–	–	–

* Combination is available.

Wind zones = I, II and III
Seismic zones = I, II, III, IV and V
Type of support = Fixed and hinged

The analysis and design results are presented for both fixed and hinged support conditions. The column height specified includes 0.5 m length of column which is embedded below ground level.

1.2 Portal Frame Configuration – For portal frames, of both fixed type and hinged type, prismatic rafters are adopted. For frames with fixed support condition, prismatic column members are adopted and for frames with hinged base, non-prismatic column members are adopted. Purlins and cladding runners are assumed to be located at a maximum spacing of 1.4 and 1.7 m on the rafter and column members respectively.

1.3 Terminology

Bay	– The space between successive bents.
Bracing	– Single or diagonal members which form a truss system with columns or rafters to provide stability and resist horizontal load.
Cladding Runners	– Members carrying side sheeting and supported by columns.
Columns	– Members generally vertical which primarily resist axial load and bending moment.
Column height	– The height of the column from top of the foundation to the junction of the centre lines of rafter and column.
Purlins	– Members carrying roof sheeting and supported by rafters.
Roof Slopes	– The slope of the rafter with respect to the span length. It is obtained by dividing the rise of the portal frame by half the span length.
Spacing of Frames	– The centre line distance of two adjacent portal frames in the longitudinal direction.
Span	– The centre line distance between the columns at top of the foundation in the transverse direction.

2. ANALYSIS

2.1 Loads – The purlins, cladding runners and portal frames are analyzed for dead load, live load and wind load, and subsequently checked for seismic load.

2.1.1 *Dead Load* – The purlins, cladding runners and portal frames are designed for their self-weight according to IS:19911-1967.[*]

2.1.2 *Live Load* – The purlins and portal frames are designed for live loads according to IS:875-1964.[†] taken with appropriate reduction for roof slopes, whenever applicable.

2.1.3 *Wind Load* – The purlins, cladding runners and portal frames are designed for the three basic wind pressure zones given in IS:875-1964.[\$] The internal pressure/suction specified in IS:875-1964,* for buildings with normal permeability (± $0.2p$) has been considered. Under each basic wind pressure, the following three different wind load conditions (*see* Drg. 142) have been analyzed:

---

[*] Since revised as IS:875 (Part 1) - 1987.

[†] Since revised as IS:875 (Part 2) - 1987.

[\$] Since revised as IS:875 (Part 3) - 1987.

a) Wind perpendicular to the ridge with internal suction (*WL* 1)
b) Wind perpendicular to the ridge with internal pressure (*WL* 2)
c) Wind parallel to the ridge with internal pressure (*WL* 3)

The basic wind pressure is reduced by 25 percent for the design of all members if the height of the building is less than 10.0 m and for columns alone if the height of the building is more than 10.0 m but less than 30.0 m.

In the case of multi-bay portal frames, drag force due to wind on interior slopes has also been considered according to IS:875-1964.*

Cladding and cladding fasteners shall be designed for increased wind pressure due to local effects according to IS:875-1964.*

2.1.4 *Seismic Load* – Seismic load is generally not of significance for low rise buildings such as those considered in the Handbook. But a few cases of frames with the shortest spans and the shortest column height, and also of frames with the largest spans and the largest column height have been checked for seismic load effects. The seismic load characteristics and intensities in such cases are assumed as specified for different earthquake zones in IS:1893-1984.

Snow load has not been considered for the typification.

2.2 Analysis of Purlins – The maximum spacing of purlins is assumed to be 1.40 m centre-to-centre supporting asbestos cement sheets. Galvanized iron sheeting may be used in place of AC sheeting without any modifications. However, in case of GI sheeting, if a larger spacing than 1.40 m is to be adopted (as per recommendation of the manufacturers), the purlins will have to be suitably redesigned. The portal design will remain unaltered.

Purlins are analyzed as simply supported beams subjected to biaxial moment due to dead load, live load and wind load/seismic load as described in 2.1.

First the bending moments due to the dead load (*DL*), live load (*LL*) and the wind loads (*WL* 1, *WL* 2, *WL* 3) are computed. For checking the permissible stresses at various service load stages of 12 m prestressed concrete purlin, the load combinations as shown below are considered:

a) $DL + LL$
b) $DL + LL + WL\ 1$
c) $DL + LL + WL\ 2$
d) $DL + LL + WL\ 3$

For the purposes of design of both the reinforced concrete (RC) and prestressed concrete (PSC) purlins according to the limit state of collapse, the design forces in the appropriate planes are arrived at in accordance with IS:456-1978 and IS:1343-1980 for load combinations shown below:

a) $1.5\,DL + 1.5\,LL$
b) $1.5\,DL + 1.5\,C_n\,WL 1$
c) $1.5\,DL + 1.5\,C_n\,WL\ 2$
d) $1.5\,DL + 1.5\,C_n\,WL\ 3$
e) $0.9\,DL + 1.5\,C_n\,WL\ 1$
f) $0.9\,DL + 1.5\,C_n\,WL\ 2$
g) $0.9\,DL + 1.5\,C_n\,WL\ 3$
h) $1.2\,DL + 1.2\,LL + 1.2\,C_n\,WL\ 1$
j) $1.2\,DL + 1.2\,LL + 1.2\,C_n\,WL\ 2$
k) $1.2\,DL + 1.2\,LL + 1.2\,C_n\,WL\ 3$

Where $C_n = 0.75$ for members of building whose heights are less than or equal to 10.0 m and for columns of buildings whose height is less than 30.0 m and $C_n = 1.0$ for all other cases.

2.3 Analysis of Cladding Runners – Cladding runners of span 6.0 m and 12.0 m span are analyzed as simply supported beams for the loads described in 2.1. The load combinations considered for evaluating the design bending moments at the service load stage and the limit state of collapse are as given in 2.2.

2.4 Analysis of Portal Frames – All the portal frames are analyzed according to the principles of elastic theory for dead load, live load and wind load as described in 2.1. For simplifying the analysis, the loads are assumed to act at four intermediate points on the rafter and at one intermediate point on the column.

It is assumed that the frames are supported on an isolated footing. In the case of isolated footing, the idealized support condition for the column can be fixed end condition or hinged end condition depending on the soil strata. If the isolated footing is resting on hard rock, it can be assumed as a fixed base because the rock will not deform much to allow the rotation of the foundation, and if it is resting on normal soil, it can be assumed as hinged because due to the compressibility of the soil, the foundation can undergo a rotation relieving off the moment. In the case of the columns supported by a pile foundation, the base of the column should be assumed as fixed. Analysis has been carried out for both cases of support conditions, that is, fixed and hinged.

The portal frames have been analyzed using a plane frame computer programme which is based on stiffness method of analysis. Three degrees of freedom are assumed at each node. In this method, the structure coordinates are specified at all the nodal points including the supports. The number of forces at each node is equal to the possible degrees of freedom per node that are inputted. Then, the stiffness matrix of the structure is assembled and the boundary conditions are incorporated. The resulting simultaneous equations are solved for displacements, using which the member end actions are finally obtained.

---

*Since revised as IS:875 (Part 3) - 1987.

3. DESIGN

3.1 Materials

3.1.1 *Concrete* – Since the designs presented in the Handbook could be used either for a cast *in-situ* construction or for a precast construction, M25 concrete is used for the design of all portal frames, and of 6.0 m span RC purlins and cladding runners. For the illustrative design of bracings in concrete, M25 concrete is used. The 12.0 m span PSC purlins and cladding runners are designed using M40 concrete which is the minimum grade prescribed for pretensioned prestressed concrete work. For the illustrative design of foundation, M15 concrete is used.

3.1.2 *Steel* – High yield strength deformed bars conforming to IS:1786-1985 are used as reinforcement in all RC members except in case of ties for purlins and cladding runners for which mild steel conforming to IS:432 (Part 1)-1982 is used. The pretensioned prestressed concrete purlins and cladding runners of 12.0 m span are assumed to be prestressed using 3 ply, 3 mm diameter uncoated stress-relieved strands conforming to IS:6006-1983.

3.2 Basic Criteria for Design

3.2.1 *Limit States of Collapse and Serviceability* – Design of reinforced concrete or prestressed concrete structural members is carried out to satisfy the criteria laid down in IS:456-1978 and IS:1343-1980 for safety against limit state of collapse, and limit states of cracking and deflection at working load stage, whenever available. In addition to the specific guidelines available in the respective Indian Standards for ensuring the required safety against limit state of collapse, both for reinforced concrete members and prestressed concrete members, the safety against cracking is assured in prestressed concrete members through the provision of limiting stresses under working load stage. IS:456-1978 has specific recommendations also for limiting deflections of simple flexural members like purlins and cladding runners.

No specific recommendations exist at present in IS:456-1978 for calculation of crack width or on lateral deflection of structural systems such as portal frames. Crack widths have been investigated based on the formulae of ACI 318-1983 and a value of height/325 has been adopted as the limiting deflection for the lateral deflection of the portal frames when the deflections are calculated using the values of Young's modulus and effective moments of inertia as recommended in IS:456-1978.

3.2.2 *Choice of Preliminary Cross-Sectional Shape and Dimensions* – In reinforced and prestressed concrete structures, the self-weight of the structural members contributes quite significantly to the total vertical load coming on to the structural members. Furthermore, in the design of statically indeterminate structures like portal frames, the relative dimensions of different structural components influence the analysis. Hence, considerable thought had to be given for the choice of cross-sectional shapes and dimensions.

The purlins and cladding runners are supported and analyzed as simply supported members of 6 or 12 m span. The cross-section shape chosen is either an angle section or a channel section because these are the most suitable ones for a member subjected to biaxial bending permitting at the same time easy fixing on to the lugs.

For the main portal frames, a solid rectangular section has been chosen mainly from the considerations of ease of construction and partly from the considerations of stiffness against lateral loads. Particularly in the case of long span and relatively high portal frames, it has been observed that the imposed limit of height/325 on the lateral deflection governs the design rather than the strength. In case a user decides to adopt a section which is governed by only strength and not deflection, then the sections can be redesigned making use of the analysis tables given in the Handbook.

3.2.3 *Load Combination Governing the Design* – From amongst the large number of load combinations listed in 2.2, the governing load is that which gives the bending moment or that combination of bending moment and axial force which requires the maximum percentage of steel at the section under consideration. Thus, it is possible that designs of different sections are governed by different combinations of the possible loads.

3.3 Design of the Purlins Cladding Runners – The purlins and the cladding runners can be of reinforced concrete, prestressed concrete or steel sections. In the Handbook, details of 6.0 m span RC purlins and cladding runners, and 12.0 m span prestressed concrete purlins and cladding runners are given. However, hot rolled angle or channel sections or cold formed Z-sections can also be used as purlins.

3.3.1 *Design of the 6.0 m Span RC Purlins and Cladding Runners* – 6.0 m span RC purlins and cladding runners are designed by the limit state method according to IS:456-1978 for the governing bending moments and shear forces obtained from the analysis. It is found that the design is not very much influenced by the variation of the roof slope and wind load/seismic load. Hence, one common design is given for all the load cases described in 2.2. Effect of torsion is neglected as it is not significant.

3.3.2 *Design of the 12.0 m Span Prestressed Concrete Purlins and Cladding Runners* – The prestressed concrete purlins and cladding runners are designed for the bending moments and shear forces described in 2.2 according to IS:1343-1980. Since it is found that the design of the purlins and cladding runners is not very much influenced by the variation in roof slopes and the wind load/seismic load, only one common design is given. This is applicable for frames with all slopes considered and for all wind zones/seismic zones.

3.4 Design of the Portal Frames

3.4.1 *Strength Design* – The critical sections of the principal rafter and the column of the portal frames are designed for all the load combinations given in 2.2. The effective length for strong axis buckling under axial compression of the columns has been considered as 1.5 times the actual columns height for fixed type of support and 2.25 times the actual length for hinged type of support according to the provisions of IS:456-1978. The effective length for weak axis buckling of columns under axial compression has been considered as 0.75 times the height for fixed and hinged type of supports following the provisions of IS:800-1962. The columns are designed for bending moment along minor axis also, wherever applicable.

It is found that the design of the critical cross-sections of a portal frame is not very much influenced by the variation in slopes and wind/seismic loads. Hence, common designs are worked out which are applicable for all slopes and wind/seismic forces. With the critical cross-sectional details being common for all slopes, the influence of the slope has been incorporated while fixing the lengths of the rafters, location at which bars could be curtailed and other points related to reinforcement detailing. Normal clear cover according to IS:456-1978 is assumed in the design. In a particular case, if additional cover has to be provided due to aggressive environment, etc, then the column dimensions have to be increased to the extent of increase in the cover. In the design of the rafter, the effect of axial force is neglected as it is not significant.

3.4.2 *Deflection* – As already mentioned, it is ensured that the lateral deflection at the top of the columns is less than 1/325 of height of the columns under the worst combination of all the vertical and lateral loads. It is significant to note here that a considerable portion of the lateral deflection at the top of the column is due to the action of vertical loads themselves.

3.4.3 *Crack Width* – The maximum widths of the cracks in the portal frames are checked according to ACI-318-1983 and they are found to be within the permissible values.

3.4.4 *Special Considerations for Frames in Seismic Zones* – As mentioned in 2.1.4, some of the frames with largest span and largest column height, as well as shortest span and shortest column height are analyzed for seismic forces. It is found that the seismic forces do not govern the strength design. However, the joints in the frames to be constructed in areas where seismic coefficient is 0.05 or more are to be so detailed that enough ductility is ensured according to IS:4326-1976. These special joint details should be incorporated at the joints of the frames to be constructed in areas where seismic coefficient is 0.05 or more even though the seismic load does not govern the design.

4. RESULTS OF PORTAL FRAMES: ANALYSIS AND DESIGN

4.0 The results of the extensive analysis and design work carried out for the large number of portal frame configurations as described in the earlier clauses are presented in the form of detailed design drawings and tables.

Whereas the detailed design drawings prepared can be straight away adopted for fabrication and erection, they are naturally strictly valid only for the definite set of assumptions like the material properties, section dimensions and other relevant data chosen as the basis for design. On the other hand, information given in the analysis tables about bending moments, shear forces and axial forces at critical sections will at times be useful to such of those designers who may, for valid reasons, like to adopt different materials, say M20 grade of concrete, for example, or deviate marginally from the section dimensions chosen. The values obtained for design bending moments, shear forces and axial forces in the present analysis should be applicable quite closely for any frame of the same overall dimensions as long as the areas and moments of inertia of the alternative sections chosen do not deviate too much from those adopted in the designs presented in the Handbook. In a large number of cases, such values will be of immense use at least in working out preliminary designs. Hence, information is presented in the form of design tables which give the design bending moment, shear force and axial forces not only at all critical sections of the portal frames but also at the foundation level of each frame.

4.1 Design Tables

4.1.1 *Portal Frames* – Tables 1 to 140 give complete information about bending moments, shear forces and axial forces at all the critical sections for each of the 140 portal frames typified in the Handbook. All the values given for the critical sections of the portal frames are for the ultimate load stage. It may, however, be noted that the combination of loadings governing the design of different critical sections may be different and hence the design bending moments, shear forces and axial forces given in each of the tables for each critical section may be from a different set of load combinations. This is appropriately accounted for while considering the governing load combinations. It needs to be emphasized here that the bending moments, shear forces and axial forces given in Tables 1 to 140 give the values from the basic analysis of the portal frames. Slenderness effects are not included in the values given in these tables. Hence, any designer who wishes to make use of the values given in these tables should be careful to take into account the additional slenderness effects, wherever applicable.

4.1.2 *Foundations* – It is still common practice in our country to design the foundations based on the allowable soil pressure at working load stage. Therefore, the critical combinations of axial force, bending moment and shear force required for the design of foundations are given for the working load stage in the later part of each of the Tables 1 to 140.

Here again, it is to be noted that the data given in the tables do not take into account the additional moments caused due to slenderness of columns. Hence, while designing the foundation of the portal frames with the base of the column assumed as fixed, the additional moments due to column slenderness, if any, should be taken into account. A typical design of foundation is given in **6.5**. Design of foundations has, however, not been typified in this Handhook since the soil conditions, which vary from site to site, would influence the design of foundation. Foundations supporting the frames may be designed using simple spread footings, pile foundations or caisson foundations depending upon the type of soil and type of support conditions assumed in analysis. The column heights specified in **1.1** gives the total height of column from top of foundation to the junction of centre lines of rafter and columns. This includes 0.5 m length which is assumed below ground level. However, if firm strata is not available at this depth and the foundations are to be carried deeper, then a pedestal can be constructed as indicated in **6.5.4**.

4.2 Design Drawings

4.2.1 *Drawings of Portal Frames* – Drawings 1 to 140 give detailed drawings of all the portal frames analyzed and designed as part of the typification programme. As mentioned earlier, the influence of the slope and wind zone on cross-sectional dimensions and reinforcement required at critical sections of the portal frame is only marginal. Hence, the same cross-sectional detailing can be adopted for all wind zones and the slopes considered, namely, 1 in 3, 1 in 4 and 1 in 5. But the lengths of the rafter, the rise of the rafter at mid-span and other related geometrical quantities will be affected by the differences in geometry implied through the differences in slopes. Hence, each of the drawings 1 to 140 also contains information about the geometrical dimensions required for each of the three different slopes considered. Drawing No. 141 shows the general arrangement of RC portal frames along with its related fixtures.

Three different wind loading conditions have been considered in analysis as indicated in Drawing No. 142.

Specific notes are given in the relevant drawings. General notes pertaining to all drawings are also given.

The drawings are directly applicable for any cast *in-situ* construction planned with the assumed dimensions. For prefabricated construction, however, a few modifications are needed (*see* **5**).

4.2.2 *Drawings of Purlins and Cladding Runners* – For each of the four structural members, namely, the 6 m span RC purlin and cladding runner, the 12 m span PSC purlin, and the 12 m span PSC cladding runner, typical designs are worked out according to the guidelines already mentioned in the earlier clauses and the details are shown in the Drawing 143 and 144 respectively.

4.2.3 *Drawing of Lugs* – Details of concrete lugs required to support the purlins and bracket details of cladding runners are shown in Drawing No. 145 and **146** respectively. The fixing details of purlins and cladding runners are also given in these drawings.

The bracket details for supporting the rain water gutter along with details of external gutter and valley gutter are given in Drawing No. 147.

4.2.4 *Drawing of Eaves Beams* – To give rigidify in longitudinal direction, eaves beams have been provided as shown in general arrangement drawing No. 141. The design of eaves beams has been typified both for 6.0 m and 12.0 m spacing of portals. Separate details have been shown for precast and cast *in-situ* construction in Drawing No. 148.

4.2.5 *Ductility Requirements of Joints* – It is found that the seismic forces do not govern the design of portal frames typified. However, the joints in the frames to be constructed in earthquake zones IV and V are to be so detailed as to ensure enough ductility according to IS:4326-1976. A typical joint detail is shown in Drawing No. 149. These joint details should be incorporated in the joints of the frames to be constructed in areas where seismic coefficient is 0.05 or more.

5. MISCELLANEOUS DETAILS

5.1 Construction of Portal Frames with Precast Elements Special Precautions – If in a prefabricated construction, the connection details are so dimensioned that the members joined at the joint develop their full moment and shear carrying capacity required, then the behaviour of a prefabricated structure after jointing is essentially the same as that of a cast *in-situ* structure. Hence, from the point of view of structural behaviour, a lot of thought should go into:

a) determining the location of the joints between precast elements; and

b) detailing of the joint at the chosen location.

Incidentally, the decision on the location of the joints is influenced also by the lifting capacity of the crane available at site. The method of handling individual elements and the erection procedure also have to be taken into account in detailing of the reinforcements in individual elements. The frames given in Drawing No. 1 to 140 can be constructed also out of precast elements according to the procedure described below.

5.2 Suggested Scheme of Casting and Erection – The frames are cast as segments as shown in Drawing No. 150. The segments are cast flat on the ground. They are lifted in horizontal position using the points for transportation shown in Drawing No. 150. Schematic details of different types of fixtures used for handling precast members are given in Drawing No. 151. Then the columns are tilted, erected, aligned and laterally braced. Temporary bracings and other such precautions should be taken, as found necessary during erection. The columns are erected using the holes provided for erection as shown in Drawing No. 150. The distances marked as *a* and *b* in Drawing No. 150 are given in Table 141. The typical details of the connection between precast columns and foundations in the case of fixed bases and hinged bases are shown in Drawing No. 152 for the typical design worked out in **6.5.2** and **6.5.3.2**. Of course, any other suitable details can also be adopted depending on the site conditions. Next, the rafter is erected in the vertical position using the holes provided for erection. The tie member shall be suitably tightened before lifting so that there are no erection stresses induced in the rafter. After aligning, the joints are made. It is always desirable to provide the joints in the rafter at the points of contraflexure. But these points will get shifted depending on the loading condition. Hence, it is not possible to fix a permanent point of contraflexure. So there can be some bending moments in the joints. Hence, it is advisable to provide a moment resisting connection. Two typical joint details are shown in Drawing No. 153. The salient dimensions indicated in Drawing No. 153 are given in Table 142. As in the case of the connection between columns and foundations, any other suitable connection details can also be adopted depending on the field conditions.

The basic aim during erection should be to commence and complete the erection of an end bay or group of bays in which bracing has been incorporated before proceeding with the erection of the remainder of the structure. Components of the end bay or bays will require support until the bracing has been completed. Purlins and cladding runners should not be relied upon to provide stability.

When permanent bracings are included elsewhere in the building than in the end bay, erection should commence at the bay or group of bays where they have been incorporated, unless temporary bracing is used. Where nature of design precludes erection in the foregoing manner, proper steps should be taken to provide alternative support.

Precast reinforced concrete, and prestressed concrete purlins and cladding runners are handled at the support points during erection and these are shown in the respective drawings. They should be lifted in the same position in which they are to be finally placed at site.

5.3 Suggested Locations of Joints – Although one should try to have a joint with sufficient moment resisting capacity, it is always an advantage to have the joints at the point of contraflexure or at least in a zone with very small bending moments. Table 141 gives the information about the recommended points at which joints and lifting hooks can be provided in the rafters and in the columns for all the 140 frames typified in this Handbook. The main reinforcement in the precast column and rafter members need not undergo any change from what has been given in Drawing No. 1 to 140 as they are found to be adequate to withstand possible handling stresses also.

5.4 Bracing – Even though bracing may appear to be a secondary matter, it is highly important and deserves careful attention. Probably more failures, or at least unsatisfactory performances, have resulted from inadequate bracing than from deficiencies in main framing. There can be several alternatives by which loads can be carried to the ground and in a number of bays redundant diagonals may be used. This makes the design of bracing in even simple structures highly indeterminate.

In order to ensure stability in the longitudinal direction, to take the wind forces acting on gable end and the forces due to wind drag on roof, bracings have to be provided at the rafter level and in the vertical plane between columns. Normally, these bracings are provided in the end bays – one at each end of building. If the length of the building is large, bracings are provided in some of the intermediate bays also. A typical arrangement of bracings is shown in Drawing No. 154.

The diagonal bracing members can be either in concrete or in steel. Section dimensions required for the bracing members either in concrete or in steel depend on the total horizontal force coming on the building in the longitudinal direction. This, in turn, depends on the area of the gable end of the building, surface area of the roof and the wind zone in which the building is situated. A design of such a bracing in concrete and in steel for one typical case is presented in **6.6**. Details of the bracings designed in the illustrative example are shown in Drawing No. 155. The bracings needed in any given case can be designed on similar lines. Typification for bracing has not been attempted since lot of variations are possible due to different design parameters like length of building, span, spacing, height, wind zone, etc.

5.5 Expansion Joints – Expansion joints have to be provided after taking into consideration various factors, such as temperature, exposure to weather, the time and season of laying of concrete. For the purpose of general guidance, however, it is recommended that structures exceeding 45 m in length shall be divided by one or more expansion joints.

The structures adjacent to the joint should preferably be supported on separate columns but not necessary on separate foundations. The wind bracing is discontinuous across expansion joint and hence the bracing systems should be structurally independent in each segment of the structure separated by expansion joints.

5.6 The use of the data represented in Tables 1 to 140 is illustrated by means of an example worked out in full detail in Section 6. The design example illustrates completely the procedure to be followed in the design of purlins, cladding runners, the portal frame proper and also in the design of a suitable foundation and bracing system.

For laying of asbestos cement sheets, recommendations of IS:3007(Part 1)-1964 shall be followed.

6. ILLUSTRATIVE DESIGN EXAMPLE

6.1 Basic Data

Plan area of the factory building = 18.0 m x 30.0 m
Span of the portal frame = 18.0 m
Number of bay = 1
Height of the column above the foundation = 6.5 m
Slope of the roof = 1 in 3 (18.435°)
Type of support at the base of the column = Fixed
Spacing of the frames = 6.0 m
Location of building = Madras
Basic wind pressure = 2 kN/m^2
Type of sheeting = AC sheeting

Assume building of normal permeability.

6.2 Design of the Cladding Runner – It is assumed that AC sheet cladding is provided. The sheets are supported on RC cladding runners spaced at 1.70 m centre-to-centre. The width of the frame is 400 mm.

6.2.1 *Span* – Effective span of the cladding runner

= 6 000–10–10–95–95
= 5 790 mm.

6.2.2 *Loads*

6.2.2.1 *Dead load*

Weight of roof material = 17 kg/m^2
(including extra weight due to overlaps and fasteners)

The dead load acts in the vertical plane.

Assume L-shaped cladding runner of size =250 mm x 300 mm x 50 mm
Weight of the sheet =0.17 x 1.7 = 0.289 kN/m
Self-weight of the cladding runner =(0.2 x 0.05 + 0.30 x 0.05) x 25
=0.625 kN/m
Miscellaneous load =0.035 x 1.7 = 0.060 kN/m
Total dead load =0.289 + 0.625 + 0.060
=0.974 kN/m

6.2.2.2 *Wind load* – The wind load acts in the horizontal plane. When the wind blows perpendicular to the ridge, the wind load on the cladding runner

$$= 0.75 \times 0.7 \times 2 \times 1.7 = 1.785 \text{ kN/m}$$

6.2.3 *Design Forces* – Effect of torsion is neglected as it is insignificant and only the effect of bending and shear is considered.

6.2.3.1 *Design forces due to dead load* – Design moment for limit state design or factored moment*

$$= \frac{1.5 \times 0.974 \times 5.79^2}{8}$$

$$= 6.12 \text{ kN·m}$$

Shear force due to factored loads V_u $= \frac{1.5 \times 0.974 \times 5.79}{2}$

$$= 4.23 \text{ kN}$$

6.2.3.2 *Design forces due to wind load* (wind, blowing normal to ridge),

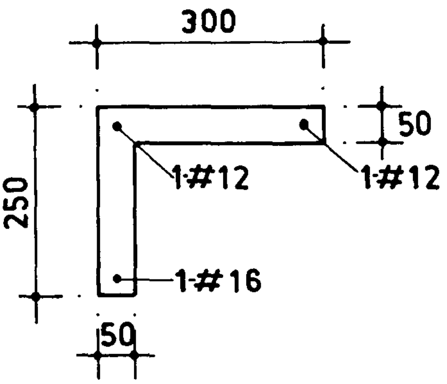
Factored moment $= \frac{1.5 \times 1.785 \times 5.79^2}{8}$

$$= 11.22 \text{ kN·m}$$

Factored shear force $= \frac{1.5 \times 1.785 \times 5.79}{2}$

$$= 7.75 \text{ kN}$$

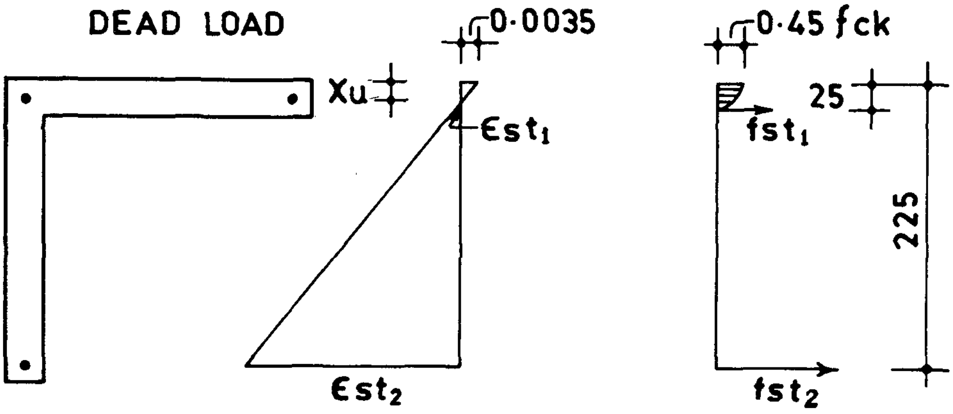
6.2.4 *Design* – Let the area of steel for the cladding runner is as shown. Then the moment of resistance under various load combinations is checked.



---

* The term 'factored moment' means the moment due to characteristic loads multiplied by the appropriate value of partial safety factor.

6.2.4.1 *Dead load*



Factored moment = 6.12 kN·m

Assume depth of neutral axis, X_u = 25 mm

Therefore, strain, $\epsilon_{st1} = 0$

and $\epsilon_{st2} = \frac{0.003\ 5}{25} \times 200$

$= 0.028$

From stress-strain curve for F_e 415 steel,

Stress, $f_{st1} = 0$

$f_{st2} = 360\ \text{N/mm}^2$

Using M 25 concrete, characteristic compressive strength,

$f_{ck} = 25\ \text{N/mm}^2$

Compressive force in concrete,

$C = 0.36\, f_{ck}\, x_u\, b$

$= 0.36 \times 25 \times 25 \times 300$

$= 67\ 500\ \text{N}$

Tensile force in steel, $T = 201 \times 360$

$= 79\ 360\ \text{N} > C$

Limiting moment of resistance, M_u, Lim $= 67\ 500 \times (225 - 0.42 \times 25) \times 10^{-6}$

$= 14.48 > 6.12$ kN·m

The section is designed for factored shear due to dead load neglecting the horizontal leg.

Factored shear force, $V_u = 4.23$ kN

Nominal shear stress, $\tau_v = \frac{4.23 \times 10^3}{50 \times 225}$

$= 0.38\ \text{N/mm}^2$

Percentage of steel neglecting the steel in the horizontal leg,

$$p_t = \frac{201 \times 100}{50 \times 225} = 1.78 \text{ percent}$$

From Table 13 of IS:456-1978, design shear stress,

$\tau_c = 0.78\ \text{N/mm}^2 > 0.38\ \text{N/mm}^2$. Hence safe.

Hence, minimum web steel according to 25.5.1.6 of IS:456-1978 may be provided.

6.2.4.2 *Dead and wind load* – The section is designed for the simultaneous action of the dead and wind load. Two cases are considered.

Case 1 : Cladding runner on the leeward side when the wind blows perpendicular to the ridge with internal pressure:

Factored moment due to dead load, M_{uD} = 6.12 kN.m

Factored moment due to wind load, M_{uW} = 11.22 kN.m

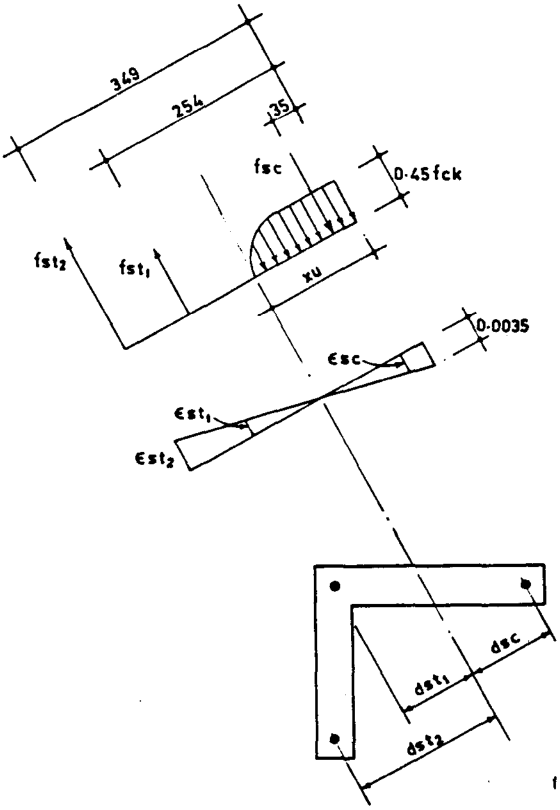
Resultant factored moment, $M_u = \sqrt{6.12^2 + 11.22^2}$

$= 12.78$ kN·m

Inclination of the neutral axis with the verticle,

$$\theta = \tan^{-1}\left(\frac{(6.12)}{11.22}\right)$$

$= 28.61°$



Assume the depth of neutral axis, X_u = 150 mm

Solving graphically,

d_{sc} = 150 – 35 = 115 mm

d_{st1} = 254 – 150 = 104 mm

d_{st2} = 349 – 150 = 199 mm

From strain diagram,

$$\text{Strain, } \epsilon_{sc} = \frac{0.003\,5 \times 115}{150} = 0.002\,7$$

$$\epsilon_{st1} = \frac{0.003\,5 \times 104}{150} = 0.002\,4$$

$$\epsilon_{st2} = \frac{0.003\,5 \times 199}{150} = 0.004\,6$$

From stress-strain curve for steel:

Stress, f_{sc} = 350 N/mm^2

f_{st1} = 342 N/mm^2

f_{st2} = 360 N/mm^2

Compressive force in concrete

$$= 0.45 \times 25 \left(\frac{1}{2} \times 58 \times 24 + 58 \times 40.2\right) + 0.45 \times 25 \times \frac{2}{3} \times 58 \times 85.8$$

$= 34\,060 + 37\,323$

$= 71\,383$ N

Resultant compressive force, C $= 350 \times 113 + 71\,383$

$= 39\,550 + 71\,383$

$= 110\,933$ N

Resultant tensile force, T $= 342 \times 113 + 360 \times 201$

$= 38\,646 + 72\,360$

$= 111\,006 \simeq C$

Hence, the assumed neutral axis is alright.

Taking the moment of all the compressive forces about the top fibre, distance of centre of compression from top fibre,

$$\bar{X} = \frac{34\,060 \times \frac{64.2}{2} + 37\,323 \times \left(\frac{3}{8} \times 85.8 + 64.2\right) + 39\,550 \times 35}{110\,933}$$

= 54.76 mm

Moment of the tensile forces about the centre of compression,

$$M_u, \text{lim} = 38\,646 \times (254 - 54.76) + 72\,363\ (349 - 54.76) \times 10^{-6}$$

$= 29.0$ kN/m $>$ 12.78 kN/m

Hence, the assumed section is alright.

Case 2 : Cladding runner on the windward side, when the wind blows perpendicular to the ridge with internal suction:

Factored moment due to dead load, M_{uD} = 6.12 kN/m

Factored moment due to wind load, M_{uW} = 11.22 kN/m

Resultant factored moment, M_u $= \sqrt{6.12^2 + 11.22^2}$

= 12.78 kN.m

Inclination of the neutral axis with the vertical

$$\theta = \tan^{-1}\left(\frac{6.12}{11.22}\right)$$

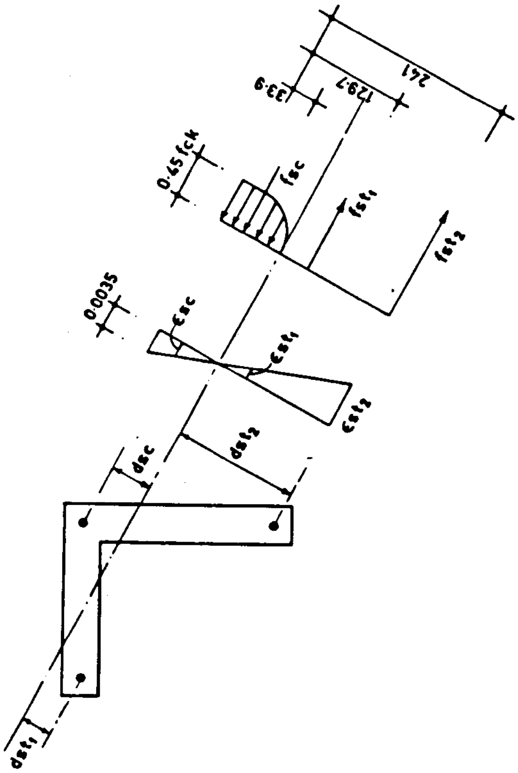
$$= 28.61°$$

Assume the depth of the neutral axis to be 90 mm

Solving graphically, $d_{sc} = 90 - 33.9 = 56.1$ mm

$d_{st1} = 129.7 - 90 = 39.7$ mm

$d_{st2} = 241 - 90 = 151$



From the strain diagram,

Strain, $\epsilon_{sc} = \frac{0.003\,5}{90} \times 56.1 = 0.002\,2$

$$\epsilon_{st1} = \frac{0.003\,5}{90} \times 39.7 = 0.001\,5$$

$$\epsilon_{st2} = \frac{0.003\,5}{90} \times 151 = 0.005\,8$$

From the stress-strain curve for steel,

Stress, $f_{sc} = 335$ N/mm²

$f_{st1} = 295$ N/mm²

$f_{st2} = 361$ N/mm²

Force in the steel,

$F_{sc} = 113 \times 335 = 37\,855$ N

$F_{st2} = 113 \times 361 = 40\,793$ N

Compressive force in concrete,

$$\simeq 0.45 \times 25 \times ½ \times 96 \times 38.6$$
$$+ (0.45 + 0.28) \times ½ \times 25 \times ½ \times (162+96) \times 28$$
$$+ ½ \times 0.28 \times 25\,(23.4 \times 56 + 102 \times 23.4)$$
$$= 20\,844 + 32\,960 + 12\,940$$
$$= 66\,744 \text{ N}$$

Resultant compressive force, C

$= 37\,855 + 66\,744 = 104\,599$ N

Resultant tensile force, T

$= 59\,295 + 40\,793$
$= 100\,088 \text{ N} \simeq C.$

Hence, the assumed neutral axis is alright.

Taking moment of all the compressive forces about the top fibre, distance of centre of compression from top fibre,

$$\bar{X} = 20\,844 \times \frac{38.6}{2} + 32\,960\,\frac{(11.25 + 2 \times 7)}{11.25 + 7} \times 28$$

$$+ \frac{12\,940 \times ½ \times 23.4 + 37\,855 \times 33.9}{104\,599}$$

$$= 29.8 \text{ mm}$$

Moment of the tensile forces about the centre of compression,

M_u, Lim $= [59\,295\,(129.7 - 29.8) + 40\,793\,(241 - 29.8)] \times 10^{-6}$

$= 14.53$ kN/m > 12.78 kN/m

Hence, the assumed section is alright for the combination of the dead load and wind load moments.

The section is designed for the maximum factored shear due to wind load neglecting the vertical leg.

Factored shear force, $V_u = 7.75$ kN

Nominal shear stress, $\tau_v = \frac{7.75 \times 10^3}{50 \times 275}$

$= 0.56 \text{ N/mm}^2$

Percentage of steel nelgecting the steel in the vertical leg,

$$p_t = \frac{113 \times 100}{50 \times 275} = 0.82$$

Design shear stress of the concrete, from Table 13 of IS:456-1978,

$$\tau_c = 0.59 \text{ N/mm}^2 > 0.56 \text{ N/mm}^2$$

Hence, nominal web reinforcement according to 25.5.1.6 of IS:456-1978 is adequate.

Assuming 6 mm diameter mild steel as single legged web reinforcement, spacing of the web steel,

$$s_v = \frac{A_{sv} \times f_y}{0.4\, b} = \frac{28 \times 250}{0.4 \times 50} = 350 \text{ mm}$$

Maximum permissible spacing according to 25.5.1.5 of IS:456-1978

$$= 0.75 \times 225 = 169 \text{ mm}$$

Therefore, provide 6 mm single legged web steel at 160 mm centre-to-centre in both the legs.

6.3 Design of the Purlins – It is assumed that the shed is covered with asbestos sheets supported by purlins placed at 1.40 m centre-to-centre.

6.3.1 *Span* – Effective span of the purlin

$= 6\,000 - 10 - 10 - 95 - 95$
$= 5\,790$ mm

6.3.2 *Loads*

6.3.2.1 *Dead load*

An L-shaped purlin of dimensions
$= 200 \times 250 \times 50$ mm is adopted.

Weight of the sheet = $0.17 \times 1.4 = 0.238$ kN/m

Self-weight of the purlin = $(0.20 + 0.20) \times 0.05 \times 25 = 0.50$ kN/m

Miscellaneous loads = $0.035 \times 1.4 = 0.049$ kN/m

Total dead load = $0.238 + 0.50 + 0.049$
$= 0.787 \text{ kN/m} \simeq 0.80 \text{ kN/m}$

6.3.2.2 *Live load* – Live load according to IS:875-1964,

$= 0.75 - 0.02\ (18.4 - 10)$
$= 0.581 \text{ kN/m}^2$

Live load on the purlin = $1.4 \times 0.581 = 0.81$ kN/m.

6.3.2.3 *Wind load* – Since the height of the entire structure is less than 10 m, the basic wind pressure = $0.75\, p$

Wind blowing parallel to the ridge gives the maximum wind load on the purlin according to IS:875-1964.

Internal pressure $= 0.8 \times 0.75 \times 2$
$= 1.2 \text{ kN/m}^2$

Wind load on the purlin $= 1.2 \times 1.4$
$= 1.68$ kN/m

6.3.3 *Design Forces*

6.3.3.1 *Design forces due to the dead load*

Bending moment due to the dead load in the vertical plane,

$$M_D = \frac{0.8 \times 5.79^2}{8}$$

$= 3.35$ kN.m

Shear force in the vertical plane,

$$V_D = \frac{0.8 \times 5.79}{2}$$

$= 2.32$ kN

Component of the moment in the normal plane,

$M_{Dn} = 3.35 \times \cos 18.4$
$= 3.18$ kN.m

Component of the bending moment in the tangential plane,

$M_{Dt} = 3.35 \times \sin 18.4$
$= 1.06$ kN.m

Shear force in the normal leg, $V_{Dn} = 2.32 \times \cos 18.4$

$= 2.20$ kN

Shear force in the tangential leg,

$V_{Dt} = 2.32 \times \sin 18.4$
$= 0.73$ kN

6.3.3.2 *Design forces due to the live load*

Bending moment due to the live load,

$$M_L = \frac{0.81 \times 5.79^2}{8} = 3.39 \text{ kN.m}$$

Shear force in the vertical plane $= \dfrac{0.81 \times 5.79}{2}$

$$= 2.35 \text{ kN}$$

Component of the live load bending moment in the normal plane,

$$\begin{aligned} M_{Ln} &= 3.39 \times \cos 18.4 \\ &= 3.22 \text{ kN.m} \end{aligned}$$

Component of the live load bending moment in the tangential plane,

$$\begin{aligned} M_{Lt} &= 3.39 \times \sin 18.4 \\ &= 1.07 \text{ kN.m} \end{aligned}$$

Shear force in the normal plane,

$$\begin{aligned} V_{Ln} &= 2.35 \times \cos 18.4^\circ \\ &= 2.23 \text{ kN/m} \end{aligned}$$

Shear force in the tangential plane,

$$\begin{aligned} V_{Lt} &= 2.35 \times \sin 18.4^\circ \\ &= 0.74 \text{ kN} \end{aligned}$$

6.3.3.3 *Design forces due to the wind load*

Bending moment due to the wind load which is in the normal plane,

$$M_w = \frac{1.68 \times 5.79^2}{8} = 7.04 \text{ kN.m}$$

Shear force in the normal plane,

$$= \frac{1.68 \times 5.79}{2} = 4.86 \text{ kN}$$

6.3.3.4 *Resultant design forces*

Case 1 : 1.5 *DL* + 1.5 *LL*

Factored moment in the normal plane,

$$\begin{aligned} M_{un1} &= 1.5 \times 3.18 + 1.5 \times 3.22 \\ &= 9.60 \text{ kN.m} \end{aligned}$$

Factored moment in the tangential plane,

$$\begin{aligned} M_{ut1} &= 1.5 \times 1.06 + 1.5 \times 1.07 \\ &= 3.2 \text{ kN.m} \end{aligned}$$

Factored shear force in the normal plane,

$$\begin{aligned} V_{un1} &= 1.5 \times 2.20 + 1.5 \times 2.23 \\ &= 6.65 \text{ kN} \end{aligned}$$

Factored shear force in the tangential plane,

$$\begin{aligned} V_{ut1} &= 1.5 \times 0.73 + 1.5 \times 0.74 \\ &= 2.21 \text{ kN} \end{aligned}$$

Case 2: 0.9 *DL* + 1.5 *WL*

Factored moment in the normal plane,

$$\begin{aligned} M_{un2} &= 0.9 \times 3.18 - 1.5 \times 7.04 \\ &= 7.70 \text{ kN.m} \end{aligned}$$

Factored moment in the tangential plane,

$$M_{ut2} = 0.9 \times 1.06 = 0.95 \text{ kN.m}$$

Factored shear force in the normal plane,

$$\begin{aligned} V_{un2} &= 0.9 \times 2.20 - 1.5 \times 4.86 \\ &= -5.31 \text{ kN} \end{aligned}$$

Factored shear force in the tangential plane,

$$V_{ut2} = 0.9 \times 0.73 = 0.66 \text{ kN}$$

Case 3: 1.2 *DL* + 1.2 *LL* + 1.2 *WL*

Factored moment in the normal plane,

$$\begin{aligned} M_{un3} &= 1.2 \times 3.18 + 1.2 \times 3.22 - 1.2 \times 7.04 \\ &= -0.77 \text{ kN.m} \end{aligned}$$

Facroted moment in the tangential plane,

$$\begin{aligned} M_{ut3} &= 1.2 \times 1.06 + 1.2 \times 1.07 \\ &= 2.56 \text{ kN.m} \end{aligned}$$

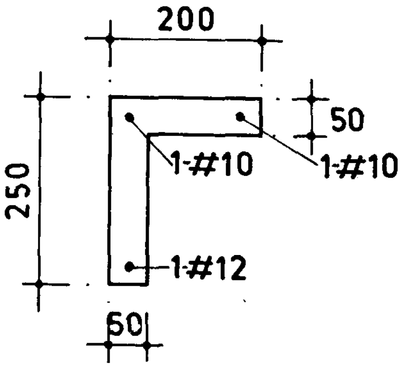
Factored shear force in the normal plane,

$$\begin{aligned} V_{un3} &= 1.2 \times 2.2 + 1.2 \times 2.23 - 1.2 \times 4.86 \\ &= -0.52 \text{ kN} \end{aligned}$$

Factored shear force in the tangential plane,

$$\begin{aligned} V_{ut3} &= 1.2 \times 0.73 + 1.2 \times 0.74 \\ &= 1.76 \text{ kN} \end{aligned}$$

6.3.4 *Design* – The purlin is reinforced with steel as shown in the figure below:



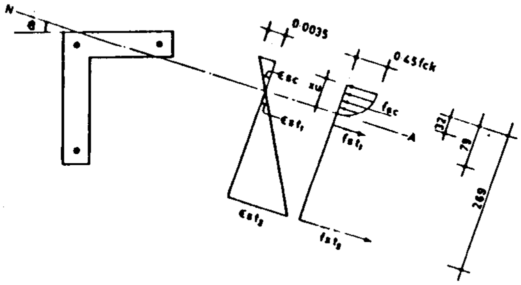
6.3.4.1 *Dead load and live load*

Resultant factored moment,

$$\begin{aligned} M_u &= \sqrt{M_{un1}^2 + M_{ut1}^2} = \sqrt{9.60^2 + 3.2^2} \\ &= 10.12 \text{ kN.m} \end{aligned}$$

Inclination of the neutral axis with the horizontal,

$$\theta = \tan^{-1}\left(\frac{3.2}{9.6}\right) = 18.4°$$



Assume the depth of the neutral axis, $X_u = 57$ mm

Solving graphically:

$d_{sc} = 57 - 32 = 25$ mm

$d_{st1} = 79 - 57 = 22$ mm

$d_{st2} = 269 - 57 = 212$ mm

From the strain diagram,

Strain, $\epsilon_{sc} = \frac{0.003\,5}{57} \times 25 = 0.001\,5$

$\epsilon_{st1} = \frac{0.003\,5}{37} \times 22 = 0.001\,4$

$\epsilon_{st2} = \frac{0.003\,5}{57} \times 212 = 0.013\,0$

From the stress-strain curve for steel,

Stress, $f_{sc} = 295$ N/mm^2

$f_{st1} = 285$ N/mm^2

$f_{st2} = 361$ N/mm^2

Force in the steel,

$F_{sc} = 79 \times 295 = 23\,305$ N

$F_{st1} = 79 \times 285 = 22\,515$ N

$F_{st2} = 113 \times 361 = 40\,793$ N

Compressive force in the concrete

$$= \left(\frac{80 \times 24}{2} + \frac{158 + 80}{2} \times 33 \times \frac{2}{3}\right) \times 0.45 \times 25$$

$= 40\,254$ N

Resultant compressive force,

$C = 23\,305 + 40\,254$

$= 63\,559$ N

Resultant tensile force,

$T = 22\,515 + 40\,793$

$= 63\,308 \text{ N} \simeq C$

Hence, the depth of the neutral axis assumed is alright.

Taking the moment of all the compressive forces about the top fibre, distance of centre of compression from top fibre,

$$\bar{X} = \frac{0.45 \times 25}{63\,559}\left[\frac{80 \times 24}{2} \times \frac{2}{3} \times 24 + \frac{(158 + 80)}{2} \times 33 \times \frac{2}{3} \times 41\right] + 23\,305 \times 32$$

$= 34$ mm

Moment of the tensile forces about the centre of compression,

M_u, Lim $= [22\,515 \times (79-34) + 40\,793\,(269-34) \times 10^{-6}]$

$= 10.6$ kN.m > 10.12 kN.m

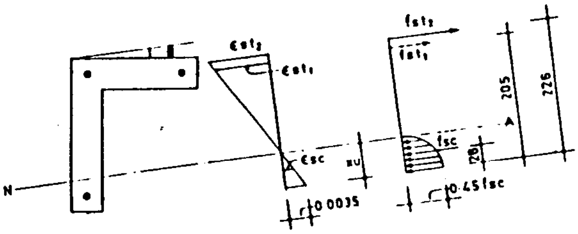
Hence, the assumed section is alright for the combination of dead load and live load moments.

6.3.4.2 *Dead load and wind load*

Resultant factored moment, $M_u = \sqrt{7.7^2 + 0.95^2}$
$= 7.76$ kN.m

Inclination of the neutral axis with horizontal

$$\theta = \tan^{-1}\left(\frac{0.95}{7.7}\right) = 7.0°$$



Assume the depth of the neutral axis, $X_u = 55$ mm

Solving graphically:

$d_{sc} = 55 - 28 = 27$ mm

$d_{st1} = 205 - 55 = 150$ mm

$d_{st2} = 226 - 55 = 171$ mm

From the strain diagram,

Strain, $\epsilon_{sc} = \dfrac{0.003\,5}{55} \times 27 = 0.001\,7$

$$\epsilon_{st1} = \frac{0.003\,5}{55} \times 150 = 0.009\,5$$

$$\epsilon_{st2} = \frac{0.003\,5}{55} \times 171 = 0.010\,8$$

From the stress-strain curve for steel,

Stress, $f_{sc} = 310$ N/mm^2

$f_{st1} = 361$ N/mm^2

$f_{st2} = 361$ N/mm^2

Force in the steel,

$F_{sc} = 113 \times 310 = 35\,030$ N

$F_{st1} = 79 \times 361 = 28\,519$ N

$F_{st2} = 79 \times 361 = 28\,519$ N

Compressive force in the concrete

$= 0.36 \times 25 \times 55 \times 50 = 24\,750$ N

Therefore, resultant compressive force,

$C = 35\,030 + 24\,750$
$= 59\,780$ N

Resultant tensile force,

$T = 2 \times 28\,519 = 57\,038\ \text{N} \simeq C$

Hence, the depth of neutral axis assumed is alright.

Distance of centre of compression from the bottom fibre,

$$\bar{X} = \frac{35\,030 \times 28 + 24\,750 \times 0.42 \times 55}{59\,780}$$

$= 26$ mm

Moment of the tensile forces about the centre of compression,

M_u, Lim $= 28\,519\,(205 + 226 - 2 \times 26) \times 10^{-6}$
$= 10.8$ kN.m > 7.76 kN.m

Hence, the assumed section is alright for the combination of the dead load and the wind load moment. The combination of the dead load, live load and the wind load does not govern the design.

Shear in the normal leg is maximum for the combination of the dead load and the live load,

Factored shear force, $V_u = 6.65$ kN

Nominal shear stress, $\tau_v = \dfrac{6.65 \times 10^3}{50 \times 225}$

$= 0.59$ N/mm^2

Percentage of steel in the normal leg,

$$p_t = \frac{113 \times 100}{50 \times 225} = 1.00 \text{ percent}$$

Design shear stress of the concrete from Table 13 of IS:456-1978,

$\tau_c = 0.64$ N/mm^2 > 0.59 N/mm^2

Hence, nominal web reinforcement according to **25.5.1.6** of IS:456-1978 is adequate.

Shear in the tangential leg is maximum for the combination of the dead load and the live load,

Factored shear force, $V_{ut} = 2.21$ kN

Nominal shear stress, $\tau_v = \dfrac{2.21 \times 10^3}{50 \times 175}$

$= 0.25 \text{ N/mm}^2$

Percentage of steel neglecting the steel in the normal leg,

$$p_t = \frac{79 \times 100}{50 \times 175} = 0.90 \text{ percent}$$

Design shear stress of the concrete from Table 13 of IS:456-1978,

$$\tau_c = 0.61 \text{ N/mm}^2 > 0.25 \text{ N/mm}^2$$

Hence, nominal web reinforcement according to **25.5.1.6** of IS:456-1978 is provided.

Assuming 6 mm diameter mild steel single legged web reinforcement, spacing of the web steel,

$$S_v = \frac{A_{sv} \times f_y}{0.4\,b} = \frac{28 \times 250}{0.4 \times 50} = 350 \text{ mm}$$

Maximum permissible spacing according to **25.5.1.5** of IS: 456-1978

$$= 0.75 \times 175 = 131 \text{ mm}$$

Therefore, provide 6 mm diameter single legged web steel at 130 mm centre-to-centre in both the legs.

6.4 Design of the Portal Frame – The design forces at various critical sections of the frame are taken from Table 11.

6.4.1 *Design of the Principal Rafter* – Assume the cross-sectional dimensions = 400 mm × 800 mm.

a) *Design for flexure*

At Section C:

Hogging, factored moment (M_u) = 422 kN.m from Table 11.

Assuming 20 mm dia bars, Fe 415 and M 25 concrete,

Effective depth (d) = 800–25–10
= 765 mm

Referring to Table D of SP: 16,

Limiting moment of resistance (M_u, Lim) = 3.45 bd^2

$$M_u, \text{ Lim} = 3.45 \times 400 \times 765^2$$
$$= 8.076 \times 10^8 \text{ N.mm}$$

Since M_u, Lim $>$ M_u, the principal rafter has to be designed as a singly reinforced beam,

$$\frac{M_u}{bd^2} = \frac{422 \times 10^6}{400 \times 765^2} = 1.802\,7$$

Referring to Table 3 of SP:16, for $\dfrac{M_u}{bd^2} = 1.802\,7$

Percentage of steel (p) = 0.55

$$A_{st} = \frac{pbd}{100} = \frac{0.55 \times 400 \times 765}{100} = 1\,683 \text{ mm}^2$$

Provide six 20 mm diameter bars, providing an area of 1 885 mm^2

Sagging, factored moment, M_u = 38 kN.m

$$\frac{M_u}{bd^2} = \frac{38 \times 10^6}{400 \times 767^2} = 0.162$$

Area of steel needed for this is less than the minimum required.

Minimum area of steel needed according to **25.5.1.1** of IS:456-1978

$$= \frac{0.85 \times bd}{f_y} = \frac{0.85 \times 400 \times 767}{415} = 628 \text{ mm}^2$$

Provide three 16 mm diameter bars, providing an area of 603 mm^2, which is nearly equal to the required.

At Section E:

Sagging, factored moment, M_u = 236 kN.m

$$\frac{M_u}{bd^2} = \frac{236 \times 10^6}{400 \times 767^2} = 1.008$$

Referring to Table 3 of SP:16, for $\dfrac{M_u}{bd^2} = 1.008$

Percentage of steel (p) = 0.292

$$A_{st} = \frac{pbd}{100} = \frac{0.292 \times 400 \times 767}{100} = 895.86 \text{ mm}^2$$

Provide five 16 mm diameter bars giving an area of 1 005 mm^2.

b) *Design for shear*

At Section C:

Factored shear force = 147 kN

Nominal shear stress, $\tau_v = \dfrac{V_u}{bd} = \dfrac{147 \times 10^3}{400 \times 765}$

$= 0.48 \text{ N/mm}^2$

Percentage of reinforcement = 0.55

Design shear stress of the concrete from Table 13 of IS:456-1978,

$$\tau_c = 0.51 \text{ N/mm}^2 > 0.48 \text{ N/mm}^2$$

Hence, it is O.K.

Hence, nominal web reinforcement according to **25.5.1.6** of IS:456-1978 is provided.

According to **25.5.1.5** and **25.5.1.6** of IS: 456-1978, spacing of the stirrups should be least of the following:

1) $S_v = \dfrac{A_{sv} \times f_v}{0.4\,b} = \dfrac{100 \times 415}{0.4 \times 400} = 260.75 \text{ mm}$

2) $S_v = 0.75\,d = 0.75\,d = 0.75 \times 765 = 573.75 \text{ mm}$

3) $S_v = 450 \text{ mm}$

Hence, provide 8 mm diameter, two legged stirrups at 260 mm centre-to-centre for the entire length of the rafter.

6.4.2 *Design of the Column*

At Section B:

Factored moment, $M_u = 422$ kN.m

Factored axial force = 191 kN

Column height (H) = 6.5 m above the foundation

Slenderness ratio along major axis $= \dfrac{1.5\,H}{D}$

$$= \frac{1.5 \times 6.5}{0.8} = 12.19 \simeq 12$$

Slenderness ratio along minor axis

$$= \frac{0.75 \times 6.5}{0.4} = 12.19 \simeq 12$$

Hence, the column is designed as a short column.

Minimum eccentricity along the minor axis according to **24.4** of IS:456-1978 $= \dfrac{6\,500}{500} + \dfrac{800}{30}$

$$= 13 + 27 = 40 \text{ mm}$$

Factored bending moment along the minor axis

$$= 191 \times 0.04 = 7.6 \text{ kN.m}$$

This is negligible and the nominal reinforcement provided along the longer face can take care of this moment.

Provide equal reinforcement on two opposite sides and assuming 20 mm diameter bars,

$$d' = 40 + 10 = 50 \text{ mm}$$

$$\frac{d'}{D} = \frac{50}{800} = 0.062\,5 \simeq 0.1$$

$$\frac{P_u}{f_{ck}bD} = \frac{191 \times 10^3}{25 \times 400 \times 800} = 0.024$$

$$\frac{M_u}{f_{ck}bD^2} = \frac{422 \times 10^6}{25 \times 400 \times 800^2} = 0.066$$

From Chart 32 of SP:16,

$$\frac{p}{f_{ck}} = 0.037$$

$p = 0.925$ percent

$A_s = 2\,960 \text{ mm}^2$

Therefore, $A_{st} = A_{sc} = 1\,480 \text{ mm}^2$

Provide ten 20 mm diameter bars giving an area of 3 141 mm^2.

Provide 8 mm diameter lateral ties.

According to **25.5.3.2** of IS:456-1978, spacing of lateral ties is the minimum of:

1) 400 mm

2) 16 × 20 = 320 mm

3) 48 × 8 = 384 mm

Hence, provide 8 mm diameter lateral ties at 300 mm centre-to-centre.

6.5 Design of the Foundation – The illustrative problem is the foundation for columns with fixed base and the forces for which the foundation is designed are taken from Table 11. These values are reproduced below:

Foundation forces at service load stage:

Load	*Axial Force* (kN)		*Bending Moment* (kN.m)	*Shear Force* (kN)
	Compression	*Tension*		
DL	156	–	167	58
LL	26	–	41	15
WL	–	20	31	15

Typical design of the foundation is worked out considering the column to be cast *in-situ* and also to be precast.

6.5.1 *Case 1: Cast* in-situ *Construction* – Assume the depth of the foundation to be 750 mm.

Moment, $M = (167 + 41 + 31) + 0.75(58 + 15 + 15)$
$= 305$ kN.m

Total axial load, $P = 156 + 26 - 20 = 162$ kN

Assuming the self-weight of footing to be 10 percent of the above load,

$P = 162 \times 1.1 = 178.2$ kN

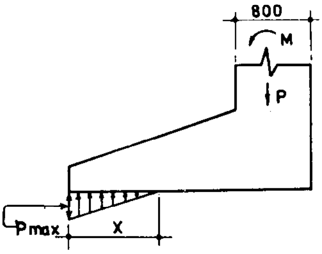
Eccentricity, $e = \dfrac{M}{P} = \dfrac{305}{178.2} = 1.711$ m

Since the eccentricity is very large and there is no possibility for reversal of moments, owing to small wind load moment compared to the dead load and live load moments, an eccentric footing is adopted.

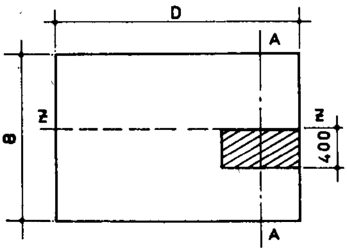
The size of the column is 400 mm x 800 mm.

Safe bearing capacity of the soil = 400 kN/m^2 (assumed)

Maximum permissible edge pressure = 1.25×400
$= 500$ kN/m^2



ELEVATION



PLAN

From force equilibrium,

$$\frac{P_{\max}}{2} BX = P \quad \ldots\ldots\ldots\ldots\ldots\ldots(1)$$

From moment equilibrium about axis AA,

$$\frac{P_{\max}}{2} BX\left(D - \frac{X}{3} - 0.4\right) = M \quad \ldots\ldots\ldots\ldots\ldots(2)$$

Assume $P_{\max} = 500$ kN/m^2 ; $B = 1.2$ m

Solving the two equations

$X = 0.594$ m

$D = 2.30$ m

6.5.1.1 *Structural design for bending moment* From the forces given, it can be seen that the load combination governing the design is *DL + LL*. Under this loading condition, the net pressure distribution is as shown below. M15 concrete and Fe415 steel are used.

Let cover to centre of reinforcement be 50 mm

effective depth = 750 – 50 = 700 mm

Moment, $M = 167 + 41 + 0.70(58 + 15) = 259$ kN.m

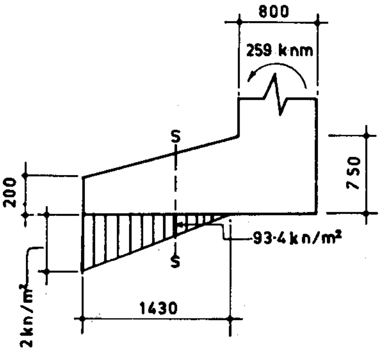
Total axial load, $P = 156 + 26 = 182$ kN

Let maximum pressure be p, then

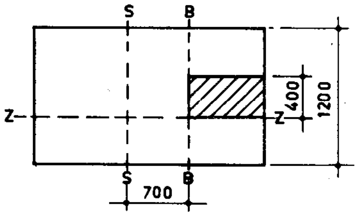
$$p\frac{X}{2} \times 1.2 = 182 \text{ and}$$

$$p\frac{x}{2} \times 1.2\left(2.3 - 0.4 - \frac{x}{33}\right) = 259$$

Solving the above equations, we get $P = 212$ kN/m^2 and $x = 1.43$ m



ELEVATION



PLAN

Factored bending moment about section BB,

$$M_u = 182 \times 105 \times (2.3 - 0.8 - \frac{1.43}{3})$$

$$= 279.4 \text{ kN.m}$$

$$\frac{M_u}{bd^2} = \frac{279.4 \times 10^6}{400 \times (700)^2} = 1.43$$

From Table 1 of SP:16,

$p_t \doteq 0.454$ percent

$$\text{Therefore, } A_{st} = \frac{0.454}{100} \times 400 \times 700$$

$$= 1\ 272 \text{ mm}^2$$

Provide twelve 12 mm diameter rods giving an area of 1 357 mm^2.

Factored shear force about section

$$\text{SS, } V_u = 1.5 \times 1.2 \left(\frac{212 + 93.4}{2}\right) \times 0.8$$

$$= 219.9 \text{ kN}$$

Factored bending moment about section SS,

$$M_u = (93.4 \times 0.8 \times 1.2 \times 0.4 + \frac{118.6 \times 0.8 \times 1.2 \times 0.8 \times 2}{2 \times 3})\ 1.5$$

$$= 99.4 \text{ kN.m}$$

Effective depth at this section,

$d = 434$ mm

Net factored shear force, $V_u - \frac{M_u}{d} \tan\beta$

$$\text{(39.1.1 of IS: 456-1978)} = 219.9 - \frac{99.4 \times 0.37}{0.434}$$

$$= 135 \text{ kN}$$

Nominal shear stress,

$$\tau_u = \frac{135 \times 10^3}{1\ 200 \times 434} = 0.26 \text{ N/mm}^2$$

Design shear stress,

$$\tau_c = 0.438 \text{ N/mm}^2 > 0.26 \text{ N/mm}^2.$$

Hence, the section provided is adequate. Since the bending moment in the other direction being very small, only nominal reinforcement is provided.

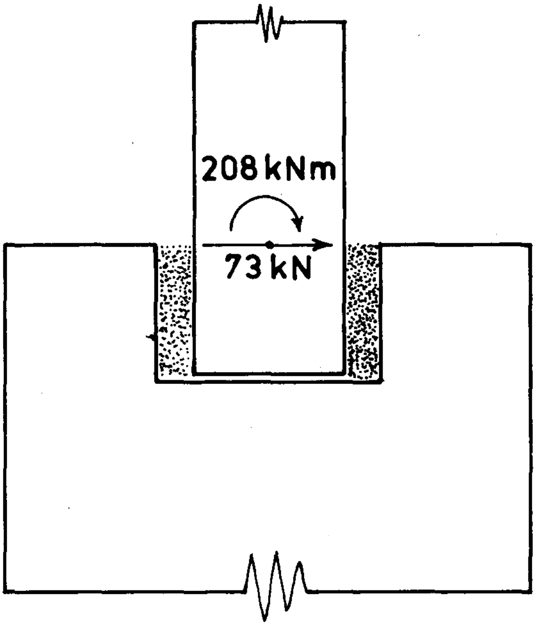
$$\text{Area of steel required} = \frac{0.12}{100} \times 2\ 300 \times \left(\frac{200 + 750}{2}\right) = 1\ 311 \text{ mm}^2$$

Provide 12 bars of 12 mm diameter

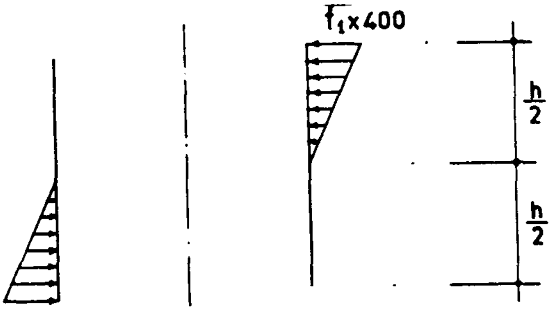
(A_{st} = 1 357 mm^2)

Details of the foundation are shown in Drawing No. 155(a).

6.5.2 *Case 2: Precast Column and Cast* in situ *Foundation* — A socket type connection is adopted. Such a connection is generally accepted as a good detail for flexurally rigid footings and is also simple to achieve. Overall plan dimensions of the foundation are arrived at as illustrated in Case 1 : cast *in-situ* construction. Hence, only the design of the socket is illustrated here.



6.5.2.1 *Depth of socket* — The socket is designed for bearing stress due to the column on the inner and outer faces of the socket. Bearing stress on the faces due to moment is shown below:



As in the previous case, governing load combination is $(DL + LL)$.

Assuming the depth of the socket to be 800 mm, the factored design bending moment,

$$M_u = (208 + 73 \times 0.40)\ 1.5$$
$$= 356 \text{ kN.m}$$

Factored design horizontal force $= 73 \times 1.5$
$= 110$ kN

Permissible bearing stress $= 0.45 f_{ck}$
$= 0.45 \times 25 = 11.25 \text{ N/mm}^2$
(according to **34.4** of IS:456-1978)

Equating resisting and applied moments,

$$11.25 \times \tfrac{1}{2} \times 400\ h/2 \left(\frac{2}{3} \times \frac{h}{2} + \frac{2}{3} \times \frac{h}{2}\right) = 356 \times 10^6$$

Solving for h,

$$h = 689 \text{ mm}$$

Hence, provide an insertion of 800 mm. For 800 mm insert, let actual bearing stress be f_1.

$$\frac{1}{2} . f_1 \times 400 \times \frac{800}{2} \left(2 \times \frac{800}{3}\right)$$
$$= 356 \times 10^6 \text{ N/mm}$$

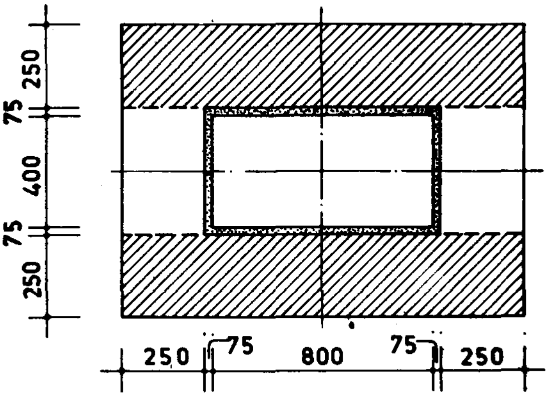
$$f_1 = 8.3 \text{ N/mm}$$

Additional bearing stress due to shear force

$$= \frac{110 \times 1\,000}{800 \times 400} = 0.34 \text{ N/mm}^2$$

Total bearing stress $= 8.3 + 0.34 = 8.64$
$= \text{N/mm}^2 < 11.25 \text{ N/mm}^2$ (permissible)

6.5.2.2 *Design of the walls* – For grouting and insertion of the column, a clearance of 75 mm on all sides of the column is given. A 250 mm wall thickness for the bore is chosen.



The two side faces are presumed to take the full moment acting as cantilevers as they are very stiff in the direction of bending. The outside face of the socket will crack and become ineffective. The inner face will be under compression but is neglected. This will make the design conservative.

Total factored moment on cantilever base
$= (208 + 73 \times 0.8)\ 1.5$
$= 400$ kN.m

Width of cantilever $= 2 \times 250 = 500$ mm

Effective depth, $d = 250 + 75 + 800 + 75 + 25 + \frac{250}{2}$
$= 1\,350$ mm

$$\frac{M_u}{bd^2} = \frac{400 \times 10^6}{500 \times 1\,350 \times 1\,350} = 0.44$$

From Table 1 of SP:16,

$$p_t = 0.129$$

However, nominal steel of 0.2 percent may be provided. Provide an area $= \frac{0.2}{100} \times 1\,350 \times 500$
$= 1\,350 \text{ mm}^2$.

Use twelve 12 mm diameter bars ($A_t = 1\,357 \text{ mm}^2$) spread over both the faces of wall.

Also, the bearing forces on the socket face have to be transferred to the side walls. This will generate a separation tension at the joint. Adequate steel is needed to transfer this tension.

Total tension at the joint

$$= \frac{1}{2} \times \frac{8.64 \times 400}{10^3} \times \frac{800}{2} + 110$$
$$= 801 \text{ kN}$$

Permissible stress in steel $= \frac{1}{1.15} \times 415$
$= 360.8 \text{ N/mm}^2$

Area required to resist the tension $= \frac{801 \times 1\,000}{360.8}$
$= 2\,220 \text{ mm}^2$

Provide twenty 12 mm diameter bars
($A_t = 2\,262 \text{ mm}^2$)

These can be dispersed on both inner and outer faces, as loops in the walls of the socket.

Details of the foundation are shown in Drawing No. 151 (a).

6.5.3 *Design of Foundation for a Column with Hinged Base* — Even though the problem taken as illustration is one with fixed base column, the design of foundations for column with hinged base is also illustrated.

6.5.3.1 *Case 1: Cast* in-situ *construction* — Here, the foundation forces are taken from Table 81 for the frame with the same configuration but with a hinged base. Of course, in the case of column with hinged base, it is assumed that the footing as a whole will rotate relieving of the moments because of the compressibility of the soil. The case of structural hinge is not considered and it is not necessary to provide a structural hinge at all.

The problem illustrated assumes a safe bearing capacity of soil of 100 kN/m^2.

Column size : 500 mm x 500 mm

Foundation forces at service load stage taken from Table 81 are reproduced below:

Load	*Axial Force* (kN)		*Shear Force* (kN)
	Compression	*Tension*	
DL	191	–	41
LL	26	–	8
WL	–	14	17

Total axial force = 191 + 26 = 217 kN

Assuming the self-weight of the foundation to be 10 percent of the above.

$$\text{Area of bearing required} = \frac{217 \times 1.1}{100} = 2.4 \text{ m}^2$$

Adopt a square footing of size,

1 600 mm x 1 600 mm

Upward bearing pressure on footing

$$= \frac{217}{1.6 \times 1.6} = 85 \text{ kN/m}^2$$

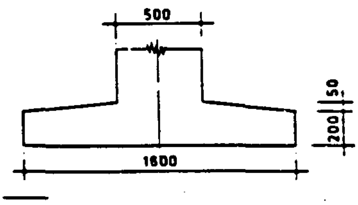
a) *Flexural design*

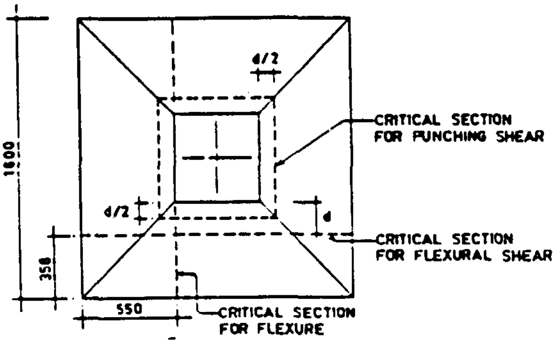
Governing load case is $(DL + LL)$

Bending moment at the face of the column

$$= 85 \times 1.6 \times \frac{0.55^2}{2} = 20.6 \text{ kN.m}$$

M15 concrete and Fe 415 steel are used.




d/2
CRITICAL SECTION FOR PUNCHING SHEAR
1600
d/2
d
CRITICAL SECTION FOR FLEXURAL SHEAR
350
550
CRITICAL SECTION FOR FLEXURE

Adopt an overall depth of 250 mm.

$$\text{Therefore, effective depth, } d \doteq 250 - 40 - \frac{12}{2} - 12 = 192 \text{ mm}$$

$$\text{Therefore, } \frac{M_u}{bd^2} = \frac{20.6 \times 1.5 \times 10^6}{500 \times 192^2} = 1.676$$

From Table 1 of SP:16,

$p_t = 0.550$ percent

$$A_{st} = \frac{0.550}{100} \times 500 \times 192 = 528 \text{ mm}^2$$

Provide nine 10 mm diameter bars in both directions.

$$A_{st} = 9 \times 79 = 706 \text{ mm}^2$$

$$\text{Therefore, } P_t \doteq \frac{706}{500 \times 192} \times 100 = 0.73 \text{ percent}$$

b) *Punching Shear*

Dimensions of the critical section:

$b = 500 + 192 = 692$ mm

$$D = 200 + \frac{50}{550} \times 454 = 241 \text{ mm}$$

$$d = 241 - 40 - \frac{12}{2} - 12 = 183 \text{ mm}$$

Punching shear

$= 85 (1.6 \times 1.6 - 0.692 \times 0.692)$
$= 176.9$ kN

Punching shear

$$= \frac{176.9 \times 1.5 \times 10^3}{4 \times 692 \times 183} = 0.52 \text{ N/mm}^2$$

Permissible shear stress in punching $= 0.25\sqrt{f_{ck}}$

$= 0.25\sqrt{15}$

$= 0.97 \text{ N/mm}^2 > 0.52 \text{ N/mm}^2$

Hence, it is O.K.

c) *Flexural Shear*

$p_t = 0.73$ percent

From Table 13 of IS:456-1978

Design shear stress $\tau_c = 0.53 \text{ N/mm}^2$

Dimensions at the critical section:

$b = 500 + 2 \times 192 = 884$ mm

$D = 232.5$ mm

$d = 232.5 - 58 = 174.5$ mm

Flexural shear

$= 85 \times 1.6 \times 0.358$

$= 48.7$ kN

Nominal shear stress,

$$v = \frac{48.7 \times 1.5 \times 10^3}{884 \times 174.5}$$

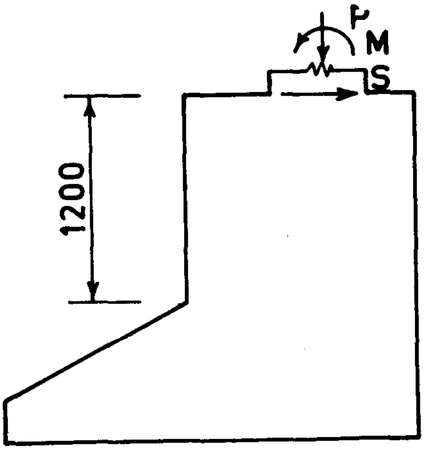
$= 0.47 \text{ N/mm}^2 < 0.53 \text{ N/mm}^2$

Hence, it is O.K.

The details of the reinforcement is shown in Drawing No. 156(b). A pedestal is provided since the development length in compression for 20 mm diameter bars is 905 mm.

6.5.3.2 *Case 2: Precast column and cast* in-situ *foundation* – Structural design of the foundation will be the same as that illustrated above. The walls of the socket is subjected to very small forces since there is no bending moment and hence only nominal reinforcement is provided. The details of the reinforcement for the foundation are shown in Drawing No. 151 (b).

6.5.4 *Design of a Pedestal* – Where embedment below ground level of the columns has to be more than 500 mm because of firm soil available at greater depth, a pedestal can be provided. A typical design of the pedestal for 1200 mm height is illustrated below. The maximum height of pedestal should normally be limited to 1 200 mm.



Size of the column = 400 mm x 800 mm

Assume the size of the pedestal to be
600 mm x 1 000 mm

Since the *DL* + *LL* combination is governing the design.

Factored axial force,

$P_u = (156 + 0.6 \times 1.0 \times 1.2 \times 25 + 26)\, 1.5$

$= 300$ kN

Factored bending moment,

$M_u = [167 + 41 + (58 + 15)\, 1.2]\, 1.5$

$= 443$ kN.m

$$\frac{P_u}{f_{ck} b D} \quad \frac{300 \times 10^3}{25 \times 600 \times 1\,000} = 0.02$$

$$\frac{M_u}{f_{ck} b D^2} = \frac{443 \times 10^6}{25 \times 600 \times (1\,000)^2} = 0.03$$

$d' = 40 + 11 = 51$ mm

$$\frac{d'}{D} = \frac{51}{100} = 0.5$$

From Chart 32 of SP:16,

$$\frac{P}{f_{ck}} = 0.015$$

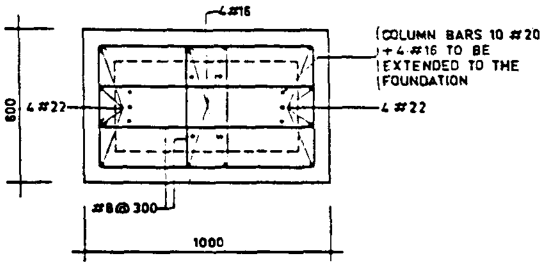
Therefore, $P = 0.015 \times 25 = 0.375$ percent

Provide 0.5 percent of the cross-sectional area of the pedestal according to 33.4.3 of IS:456-1978.

Therefore, area of steel required

$= 0.005 \times 600 \times 1\,000 = 3\,000 \text{ mm}^2$

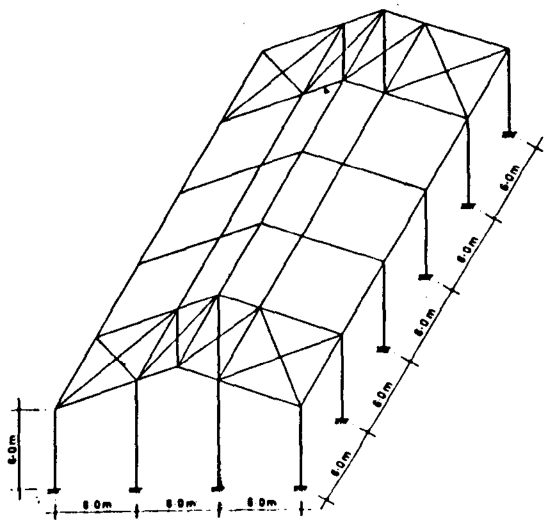
Provide eight 22 mm diameter bars, four on each face. Provide 2 bars of 16 mm dia on each of the longer face. Provide 8 mm dia links at 300 mm centre-to-centre.



SECTION OF THE PEDESTAL

6.6 *Design of Bracing* — The following example illustrates the typical design of a bracing system for a factory building of span 18 m and length 30 m made of concrete portal frames having the following salient features:

Span of the frame = 18 m
Spacing of the frames = 6 m
Height of the frame = 6.5 m
Roof slope = 1 in 3



The bracing design is worked out for a shed of 5 spacing with the arrangement of bracings as shown above.

Basic wind pressure, $P = 2\ \text{kN/m}^2$

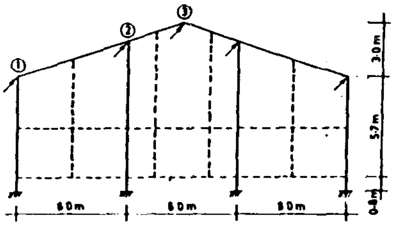
Pressure on wall $= 0.7\,p = 0.7 \times 2$
$= 1.4\ \text{kN/m}^2$

Drag pressure on roof $= 0.025 \times 2$
$= 0.05\ \text{kN/m}^2$

6.6.1 *Gable End Forces*

6.6.1.1 Due to wind pressure on gable end.

Assume 0.8 m height of brickwork above base.



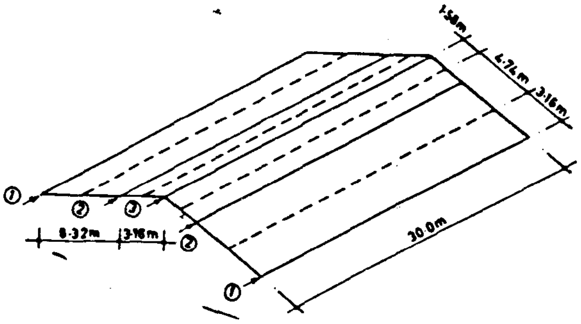
Nodal forces:

At point 1 $= \frac{1}{2}\,(5.7 + 6.7)\ 3 \times \frac{1.4}{2} = 13.0\ \text{kN}$

At point 2 $= \frac{1}{2}\,(6.7 + 8.2)\ 4.5 \times \frac{1.4}{2} = 23.5\ \text{kN}$

At point 3 $= \frac{1}{2}\,(8.2 + 8.7)\ 3.0 \times \frac{1.4}{2} = 17.8\ \text{kN}$

6.6.1.2 Due to drag force on roof



Nodal forces:

At point 1 $= \dfrac{30 \times 3.16}{2} \times 0.05 = 2.4\ \text{kN}$

At point 2 $= \dfrac{30 \times 4.74}{2} \times 0.85 = 3.6\ \text{kN}$

At point 3 $= \dfrac{30 \times 1.58 \times 2}{2} \times 0.05 = 2.4\ \text{kN}$

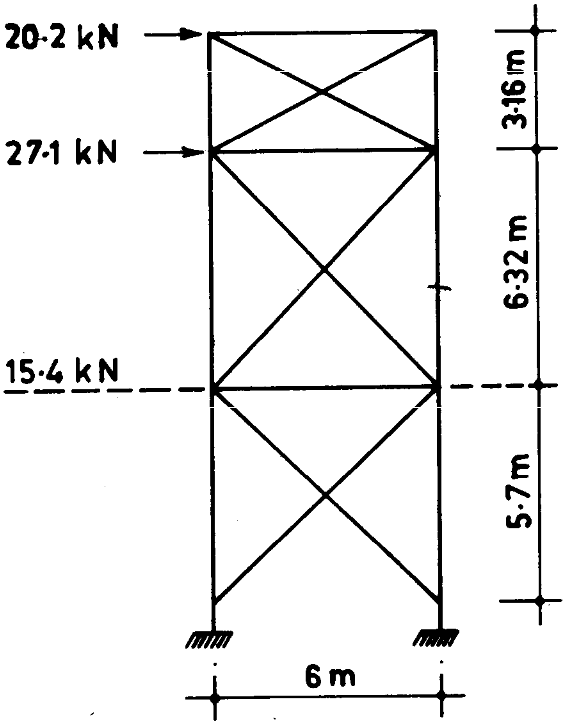
Total nodal force,

$F_1 = 13.0 + 2.4 = 15.4\ \text{kN}$

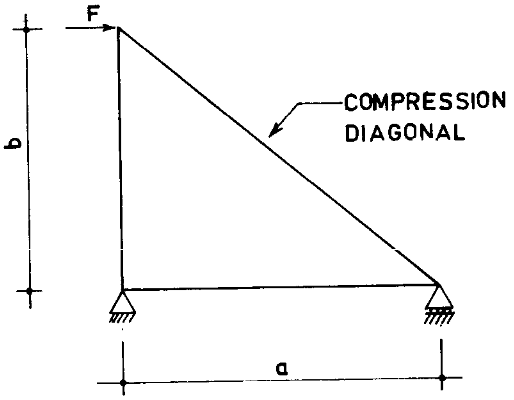
$F_2 = 23.5 + 3.6 = 27.1\ \text{kN}$

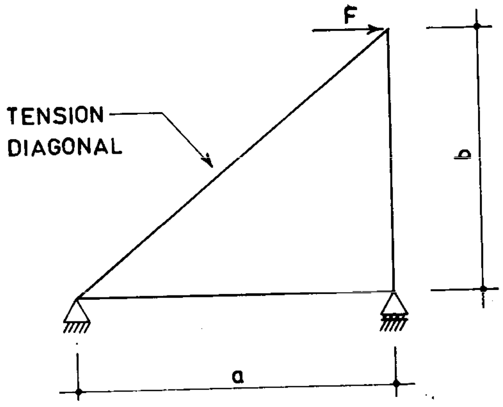
$F_3 = 17.8 + 2.4 = 20.2\ \text{kN}$

6.6.2 *Force Diagram*



In the 'X bracing', only one diagonal is normally considered as effective.

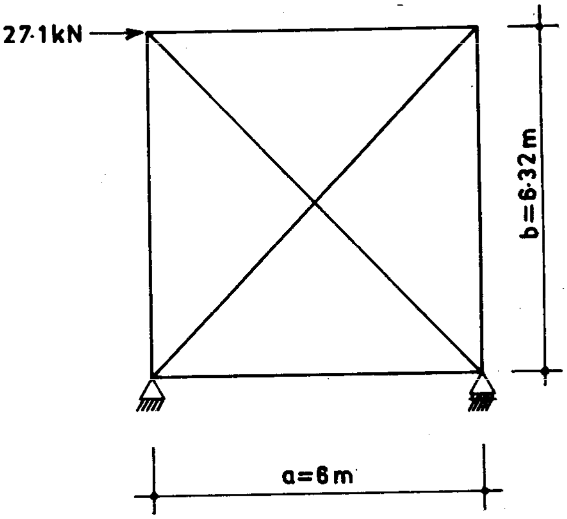




Diagonal force, $P = F \dfrac{\sqrt{a^2 + b^2}}{a}$

Critical rafter bracing

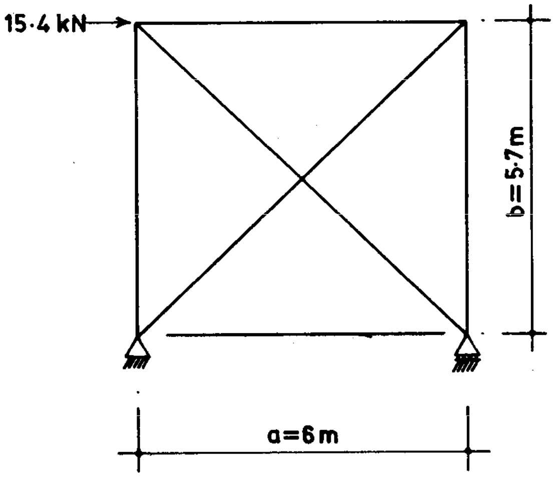
$F = 27.1$ kN



$$P = 27.1 \frac{\sqrt{6.32^2 + 6^2}}{6}$$

$= 39.4$ kN

Vertical bracing



$$P = 15.4 \frac{\sqrt{6.0^2 + 5.7^2}}{6}$$

$= 21.3$ kN

Since the rafter bracing and vertical bracing is not in same plane, therefore, some additional stresses will come on portal rafters which can be rechecked, if required. Two alternatives have been worked out for design of bracing, one using steel and other using concrete.

6.6.3 *Case 1: Steel bracing*

a) *Rafter bracing*

$$\text{Diagonal length} = \sqrt{6.32^2 + 6.0^2} = 8.72 \text{ m}$$

$$\text{Axial force} = 39.4 \text{ kN}$$

The tension diagonal member is designed and the same section is provided for the other diagonal. Consider two angles ISA: 50 x 50 x 6 mm placed back to back, with a 10 mm gusset.

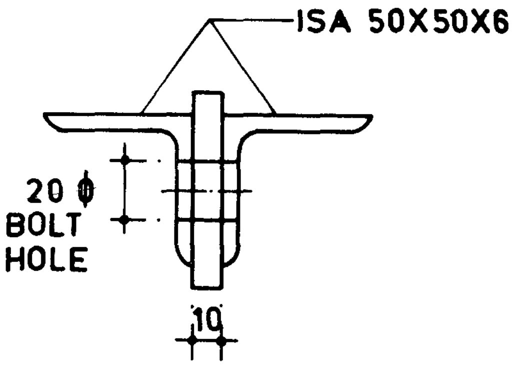
$$\text{Least slenderness ratio} = \frac{l}{r} = \frac{872}{2.46} = 354$$

which may be allowed.

$$\text{Net area} = 2 \times 5.68 - 2 \times 0.6 \times 2.15 = 8.78 \text{ cm}^2$$

Net axial capacity

$$= 0.6 \times 25\,000 \times 8.78$$
$$= 131.7 \text{ kN} > 39.4 \text{ kN}$$



b) *Vertical bracing*

$$\text{Diagonal length} = \sqrt{5.7^2 + 6.0^2} = 8.28 \text{ m}$$

$$\text{Axial force} = 21.3 \text{ kN}$$

The tension diagonal member is designed and the same section is provided for the other diagonal. Consider two angles ISA:50 x 50 x 6 mm placed back to back with a 10 mm gusset.

Net axial capacity = 131.7 kN > 21.3 kN

Hence, it is O.K.

The details of the steel bracing designed above are shown in Drawing No. 154.

6.6.4 *Case 2: Concrete Bracing* — Use M 25 concrete and Fe 415 steel.

a) *Rafter bracing*

Axial force, $P = 39.4$ kN

Factored axial force, $P_u = 1.5 \times 39.4 = 59.1$ kN

Consider cross-section of size 150 × 150 mm

Self-weight acting vertically downwards

$$= 25 \times 0.15 \times 0.15 \times \frac{8.72}{6.00}$$
$$= 0.82 \text{ kN/m}$$

Bending moment at mid-height (span) due to self-weight

$$= \frac{0.82 \times 6^2}{8}$$
$$= 3.7 \text{ kN.m}$$

Therefore, factored moment, $M_u = 1.5 \times 3.7$

$$= 5.6 \text{ kN.m}$$

The compression member is designed and the same section is provided for the other diagonal also.

P_u (compression) = 59.1 kN

M_u = 5.6 kN.m

Effective length = 8.72 m

Additional factored moment due to slenderness,

$$M_u = \frac{P_u D}{2\,000}\left(\frac{l_{ex}}{D}\right)^2$$

where

P_u = factored axial load in compression,

D = depth of cross-section at right angles to major axis, and

l_{ex} = effective length in respect of the major axis,

$$M_u = \frac{59.1 \times 0.15}{2\,000}\left(\frac{8.72}{0.15}\right)^2$$

$$\text{Total } M_u = 5.6 + 15.0 \quad = 15.0 \text{ kN.m}$$
$$= 20.6 \text{ kN.m}$$

$$\frac{P_u}{f_{ck}bD} = \frac{59.1 \times 10^3}{25 \times 150 \times 150} = 0.105$$

$$\frac{M_u}{f_{ck}bD^2} = \frac{20.6 \times 10^6}{25 \times 150 \times 150^2} = 0.244$$

From Chart 34 of SP:16,

$$\frac{p}{f_{ck}} = 0.20$$

$$p = 25 \times 0.20$$

$$= 5 \text{ percent}$$

$$A_{st} = \frac{5}{100} \times 150 \times 150$$

Therefore, adopt four 20 mm diameter bars as main reinforcement giving A_{st} = 1 256 mm².

Adopt 6 ϕ links at 150 centre-to-centre as transverse reinforcement.

b) *Vertical bracing*

Axial force, p = 21.3 kN

Factored axial force, P_u = 32.0 kN

Consider a cross-section of size 150 × 150 mm

Self-weight acting vertically downwards

$$= 25 \times 0.15 \times 0.15 \times \frac{8.28}{6.00}$$

$$= 0.78 \text{ kN/m}$$

Bending moment at mid-height (span) due to self-weight

$$= 0.78 \times \frac{6^2}{8}$$

$$= 3.5 \text{ kN.m}$$

Factored moment, M_u = 5.3 kN.m

The compression member is designed and the same section is provided for the other diagonal also.

P_u (compression) = 32.0 kN

M_u = 5.3 kN.m

Effective length = 8.28 m

Additional factored moment due to slenderness,

$$M_u = \frac{32.0 \times 0.15}{2\,000} \left(\frac{8.28}{0.15}\right)^2$$

$$= 7.3 \text{ kN.m}$$

Total M_u = 5.3 + 7.3 = 12.6 kN.m

From Chart 34 of SP:16,

$$\frac{p}{f_{ck}} = 0.12$$

$$\frac{P_u}{f_{ck}\,bD} = \frac{32.0 \times 10^3}{25 \times 150 \times 150} = 0.057$$

$$\frac{M_u}{f_{ck}\,bD^2} = \frac{12.6 \times 10^6}{25 \times 150 \times 150^2} = 0.149$$

$$P = 25 \times 0.12$$

$$= 3 \text{ percent}$$

$$A_{st} = \frac{3}{100} \times 150 \times 150$$

$$= 675 \text{ mm}^2$$

Therefore, adopt four 16 mm diameter bars as main reinforcement giving A_{st} = 804 mm².

Adopt 6 ϕ links at 150 centre-to-centre as transverse reinforcement.

The reinforcement and the connection details in the case of steel and concrete rafter bracing is shown in Drawing No. 154.

6.6.5 *Gable End Columns*

$$\text{Height} = 6.5 + \frac{1}{3} \times 6 = 8.5 \text{ m}$$

Factored moment in columns,

$$= \frac{1.4 \times 6 \times 8.5^2}{8} \times 1.5 = 113.8 \text{ kN.m}$$

Use 300 × 400 size columns,

$$\text{Slenderness ratio} = \frac{H}{D} = \frac{8.5}{0.3} = 28.33$$

Additional factored moment due to

$$\text{slenderness} = \frac{113.8 \times 0.3}{2\,000} \left(\frac{8.5}{0.3}\right)^2 = 4.6 \text{ kN.m}$$

Total M_u = 113.8 + 4.6 = 118.4 kN.m

Factored axial load, P_u (due to DL)

$$= 0.3 \times 0.4 \times 8.5 \times 25 \times 1.5$$

$$= 38.25 \text{ kN}$$

$$\frac{M_u}{f_{ck}\,bD^2} = \frac{118.4 \times 10^6}{25 \times 300 \times 400^2} = 0.099$$

$$\frac{P_u}{f_{ck}\,bD} = \frac{38.25 \times 1\,000}{25 \times 300 \times 400} = 0.013$$

$$d' = 40 + 11 = 51$$

$$\frac{d'}{D} = \frac{51}{400} = 0.128 \simeq 0.15$$

From chart 33, SP:16,

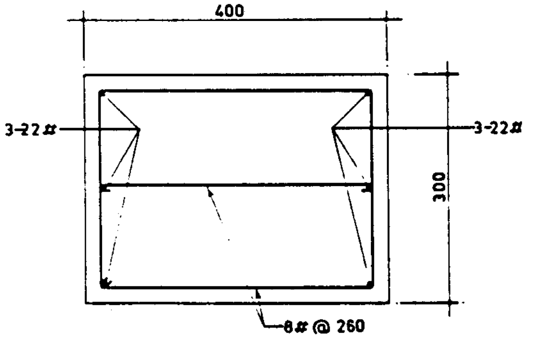
$$\frac{p}{f_{ck}} = 0.07$$

$$p = 0.07 \times 25 = 1.75 \text{ percent}$$

$$A_{st} = \frac{1.75}{100} \times 300 \times 400 = 2\,100 \text{ mm}^2$$

Use six 22 mm diameter bars ($A_t = 2\,280 \text{ mm}^2$) and 8 mm stirrups at spacing

$$0.75\,d = 0.75 \times (400-51) = 260 \text{ mm}$$ centre-to-centre



7. ESTIMATION OF QUANTITIES OF CONCRETE/ STEEL

7.1 Table 143 gives information about the material consumption according to the designs worked out for 140 portal frames typified. For ease of comparison, the information is given in the form of volume of concrete per square metre of floor area and weight of steel per square metre of floor area.

In any given situation the column-free span required and height of the building are more or less fixed by the functional requirements of the shed. One important parameter that can be chosen by the designer is the spacing of the frame in the longitudinal direction. In almost all the cases worked out, it has been observed that the 12m spacing is more economical than the 6 m spacing. The difference in the cost is about 40 percent.

If one has to cover large areas, but at the same time if there is no restriction on the minimum column-free areas required, it is obvious that multibay portal frames will be cheaper than portal frames of single large span. From the data presented in the tables, it can be seen that the cost per square metre is less by about 15 percent when the large spans of 24 to 30 meters are sub-divided into 2 or 3 shorter spans.

8. SUMMARY AND CONCLUSIONS

8.1 Reinforced concrete portal frames without cranes have been analyzed for five different spans, four different column heights, two different spacings of frames, three different roof slopes, two different support conditions for columns at the base (fixed and hinged), three different wind zones with three possible wind actions and five different earthquake zones. Again the analysis has been worked out for single bay, two-bay, three-bay and four-bay portal frames. It has been found that because of the low rise of the buildings considered, forces in the members, even due to the lowest basic wind pressure of 1.0 kN/m^2 were more than those due to the most severe earthquake zone forces. Furthermore, it was found that the governing design forces and moments in the members of the portal frames did not vary much with variation in wind zone or slope of the roof.

Total number of possible designs, considering all the above variables, could be as high as 17 280; too large number to be accommodated in any practicable typification scheme. Hence, typified designs have been worked out taking into account major parameters like span, column height, spacing of frames, number of bays and type of support conditions as variables. Then the number of problems brought down to a reasonable limit of 140 cases. The other variables play only a minor role and their worst effects were taken into account.

The analysis results in the form of design forces and moments at various critical sections of the portal frames and foundation forces at service stage are given. The design results have been presented in the form of detailed drawings to enable ready execution. For the purpose of completeness, detailed drawings for 6 and 12 m span purlins, cladding runners, and their fixing details are also furnished.

For the benefit of those who prefer to adopt prefabrication technique to cast *in-situ* construction, possible location of joints and lifting points for all the cases have been given.

Typical illustrative designs have been worked out for purlins, cladding runners, frames, foundations and bracing. Also the quantity of concrete and steel per square metre of the plan area are worked out and presented.

The following conclusions can be drawn from analysis and design results, and also from quantities estimated:

a) It is found that in most of the frames the horizontal deflection at top of the column governs the design of members except for a few frames of large spans and smaller column heights.

b) Frames with fixed base give more economical designs compared to frames with hinged base by about 10-30 percent.

c) Multibay frames are more economical than single bay frames if there is no restriction regarding the unobstructed floor area.

d) Frames of spacing 12 m are generally found to be more economical than frames of 6.0 m spacing and the economy is about 40 percent.

REFERENCES

1. IS:1911-1967* Schedule of unit weights of building materials (*first revision*)

2. IS:875-1964† Code of practice for structural safety of building: Loading standards (*revised*)

3. IS:1893-1984 Criteria for earthquake resistant design of structures (*fourth revision*)

4. IS:456-1978 Code of practice for plain and reinforced concrete (*third revision*)

5. IS:1343-1980 Code of practice for prestressed concrete (*first revision*)

6. IS:1786-1985 High strength deformed steel bars and wires for concrete reinforcement (*third revision*)

7. IS:432 (Part 1)- 1982 Mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement: Part 1 Mild steel and medium tensile steel bars. (*third revision*)

8. IS:6006-1983 Uncoated stress relieved strand for prestressed concrete (*first revision*)

9. ACI Standard 318-1983 Building code requirements for reinforced concrete. American Concrete Institute, Detroit, Michigan, USA

10. IS:800-1984 Code of practice for general construction in steel (*second revision*)

11. IS:4326-1976 Code of practice for earthquake resistant construction of buildings (*first revision*)

12. IS:3007 (Part 1)-1964 Code of practice for laying of asbestos cement sheets:Part 1 Corrugated sheets

13. SP:6(1)-1964 ISI Handbook for structural engineers : Structural steel sections (*revised*).

---

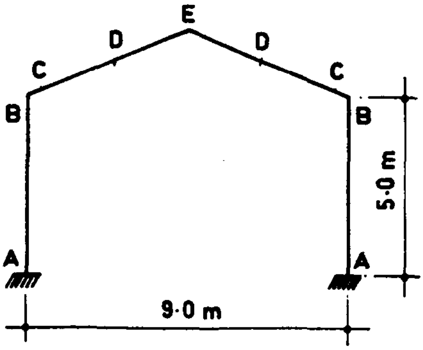
*Since revised as IS:875 (Part 1)-1987

†Since revised as IS:875 (Parts 2 to 5)-1987

As in the Original Standard, this Page is Intentionally Left Blank

TABLE 1 DESIGN FORCES

Span	:	9.0 m
Frame spacing	:	6.0 m
Column height	:	5.0 m
Roof slopes	:	1:3, 1:4, 1:5
Support condition	:	Fixed
Wind/seismic zones	:	All
Design Ultimate Forces	:	

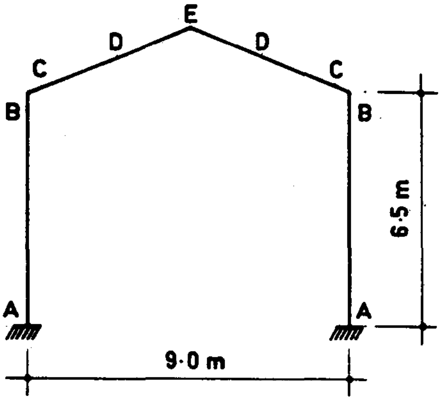


Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	70	–	37	–
B	61	–	56	–
C	61	50	–	45
D	20	33	–	23
E	16	46	–	12

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
A	*DL*	10	47	–	9
	LL	9	13	–	5
	WL	29	–	8	17

TABLE 2 DESIGN FORCES



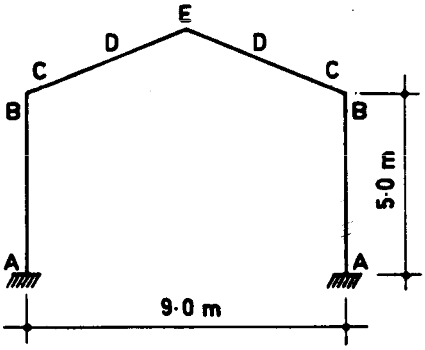
Span : 9.0 m
Frame spacing : 6.0 m
Column height : 6.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :

Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	114	–	36	–
B	75	–	38	–
C	75	64	–	53
D	26	44	–	28
E	13	61	–	16

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	20	59	–	8
	LL	9	13	–	3
	WL	29	–	21	31

TABLE 3 DESIGN FORCES



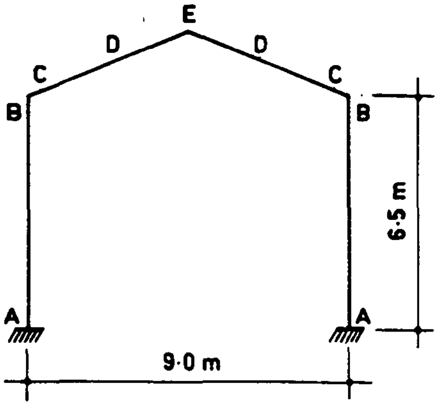
Span : 9.0 m
Frame spacing : 12.0 m
Column height : 5.0 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :

Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	153	–	95	–
B	143	–	131	–
C	143	88	–	106
D	34	79	–	55
E	22	109	–	23

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
	DL	45	85	–	22
A	*LL*	18	26	–	9
	WL	57	–	15	33

TABLE 4 DESIGN FORCES



Span : 9.0 m
Frame spacing : 12.0 m
Column height : 6.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :

Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	231	–	63	–
B	153	–	80	–
C	153	126	–	109
D	50	90	–	57
E	23	125	–	33

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	41	92	–	16
	LL	16	26	–	7
	WL	113	–	42	52

TABLE 5 DESIGN FORCES

Span : 12.0 m

Frame spacing : 6.0 m

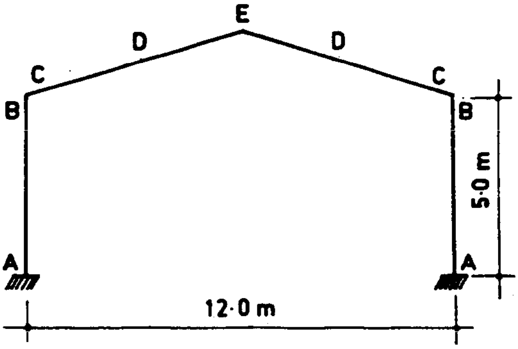
Column height : 5.0 m

Roof slopes : 1:3, 1:4, 1:5

Support condition : Fixed

Wind/seismic zones : All

Design Ultimate Forces :

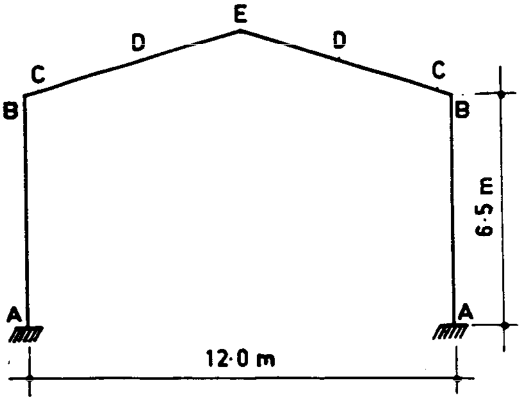


Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	109	–	77	–
B	143	–	96	–
C	143	50	–	76
D	17	66	–	38
E	12	89	–	11

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment* *(kN.m)*	*Axial Force*		*Shear Force* *(kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	50	71	–	23
	LL	17	18	–	9
	WL	23	–	13	14

TABLE 6 DESIGN FORCES



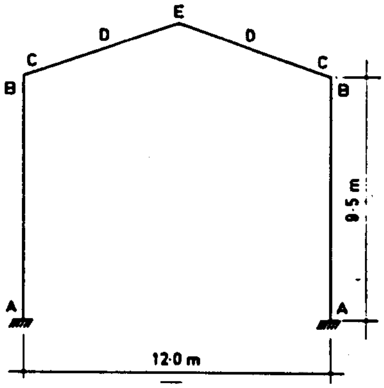
Span : 12.0 m
Frame spacing : 6.0 m
Column height : 6.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :

Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	141	–	88	–
B	141	–	96	–
C	141	68	–	78
D	25	76	–	40
E	13	105	–	15

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	46	78	–	18
	LL	16	18	–	6
	WL	48	–	11	21

TABLE 7 DESIGN FORCES



Span : 12.0 m

Frame spacing : 6.0 m

Column height : 9.5 m

Roof slopes : 1:3, 1:4, 1:5

Support condition : Fixed

Wind/seismic zones : All

Design Ultimate Forces :

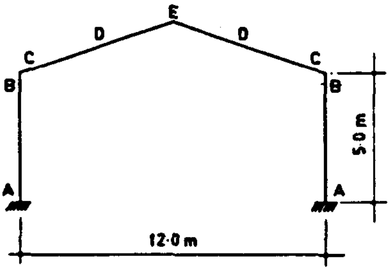
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	249	–	79	–
B	167	–	66	–
C	167	122	–	81
D	45	93	–	43
E	12	129	–	25

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
	DL	41	91	–	11
A	*WL*	14	18	–	4
	LL	125	–	26	39

TABLE 8 DESIGN FORCES

Span : 12.0 m
Frame spacing : 12.0 m
Column height : 5.00 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :



Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	198	–	112	–
B	258	–	174	–
C	258	117	–	137
D	41	118	–	68
E	35	161	–	23

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	86	106	–	40
	LL	35	35	–	17
	WL	46	–	25	27

TABLE 9 DESIGN FORCES

Span : 12.0 m

Frame spacing : 12.0 m

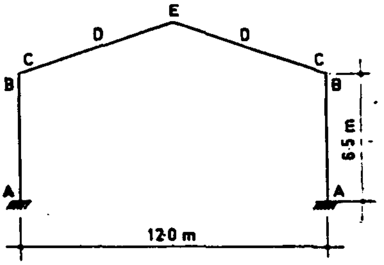
Column height : 6.5 m

Roof slopes : 1:3, 1:4, 1:5

Support condition : Fixed

Wind/seismic zones : All

Design Ultimate Forces :



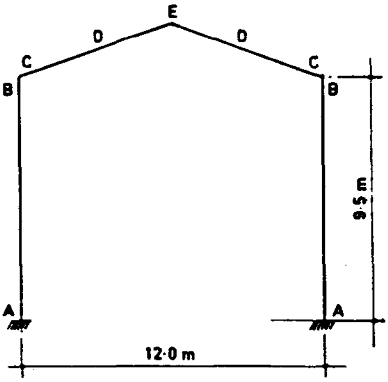
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging *(kN.m)*	*Sagging* *(kN.m)*	*(kN)*	*(kN)*
A	264	–	125	–
B	255	–	174	–
C	255	152	–	141
D	58	137	–	73
E	42	190	–	30

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment* *(kN.m)*	*Axial Force*		*Shear Force* *(kN)*
			Compressive *(kN)*	*Tensile* *(kN)*	
A	*DL*	81	113	–	30
	LL	32	35	–	13
	WL	96	–	21	43

TABLE 10 DESIGN FORCES

Span	:	12.0 m
Frame spacing	:	12.0 m
Column height	:	9.5 m
Roof slopes	:	1:3, 1:4, 1:5
Support condition	.	Fixed
Wind/seismic zones	:	All
Design Ultimate Forces	:	



Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	483	–	93	–
B	309	–	113	–
C	309	259	–	146
D	101	168	–	77
E	39	232	–	50

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment* (kN.m)	*Axial Force*		*Shear Forces* *(kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	71	127	–	20
	LL	28	35	–	8
	WL	251	–	52	79

TABLE 11 DESIGN FORCES

Span : 18.0 m

Frame spacing : 6.0 m

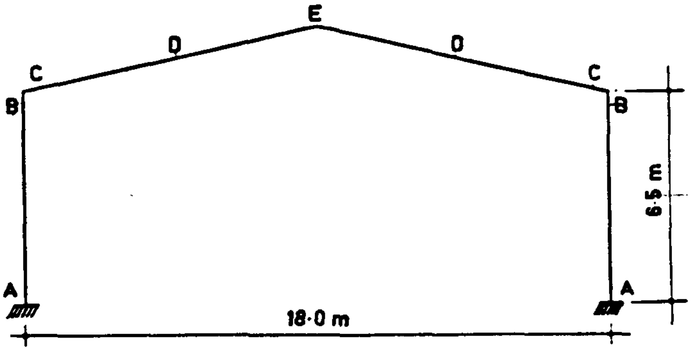
Column height : 6.5 m

Roof slopes : 1:3, 1:4, 1:5

Support condition : Fixed

Wind/seismic zones : All

Design Ultimate Forces :

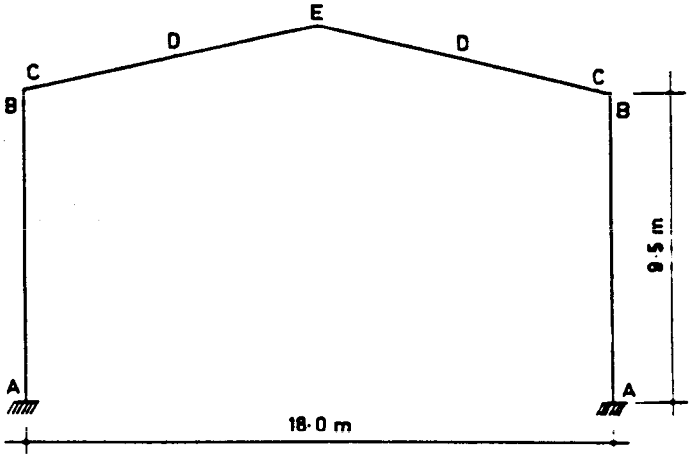


Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	300	–	243	–
B	422	–	191	–
C	422	38	–	147
D	8	179	–	72
E	–	236	–	15

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
	DL	167	156	–	50
A	*LL*	41	26	–	15
	WL	31	–	20	15

TABLE 12 DESIGN FORCES



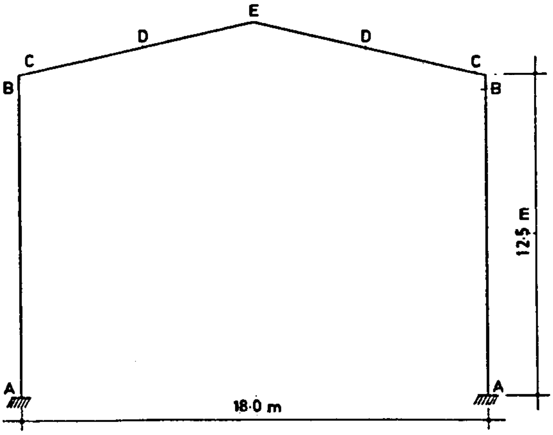
Span : 18.0 m
Frame spacing : 6.0 m
Column height : 9.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :

Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	379	–	212	–
B	421	–	191	–
C	421	86	–	154
D	21	222	–	79
E	–	308	–	21

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
A	*D L*	152	180	–	39
	L L	36	26	–	10
	W L	101	–	16	31

TABLE 13 DESIGN FORCES



Span	:	18.0 m
Frame spacing	:	6.0 m
Column height	:	12.5 m
Roof slopes	:	1:3, 1:4, 1:5
Support condition	:	Fixed
Wind/seismic zones	:	All
Design Ultimate Forces	:	

Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	515	–	197	–
B	421	–	141	–
C	421	161	–	158
D	45	258	–	83
E	–	358	–	32

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
	DL	139	204	–	28
A	*LL*	33	26	–	7
	WL	204	–	43	49

TABLE 14 DESIGN FORCES

Span : 18.0 m

Frame spacing : 12.0 m

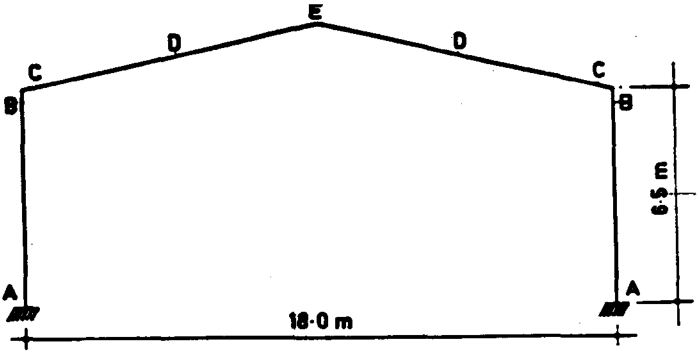
Column height : 6.5 m

Roof slopes : 1:3, 1:4, 1:5

Support condition : Fixed

Wind/seismic zones : All

Design Ultimate Forces :

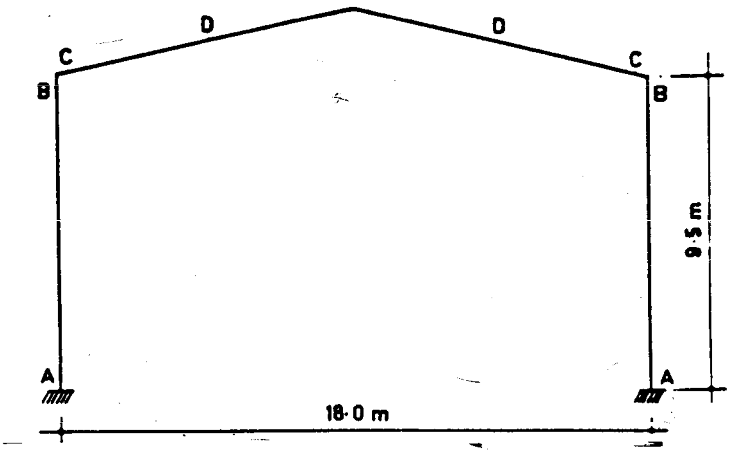


Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	479	–	362	–
B	681	–	307	–
C	681	174	–	236
D	52	288	–	116
E	36	381	–	30

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
	DL	252	210	–	87
A	*LL*	82	52	–	30
	WL	62	–	40	29

TABLE 15 DESIGN FORCES



Span : 18.0 m

Frame spacing : 12.0 m

Column height : 9.5 m

Roof slopes : 1:3, 1:4, 1:5

Support condition : Fixed

Wind/seismic zones : All

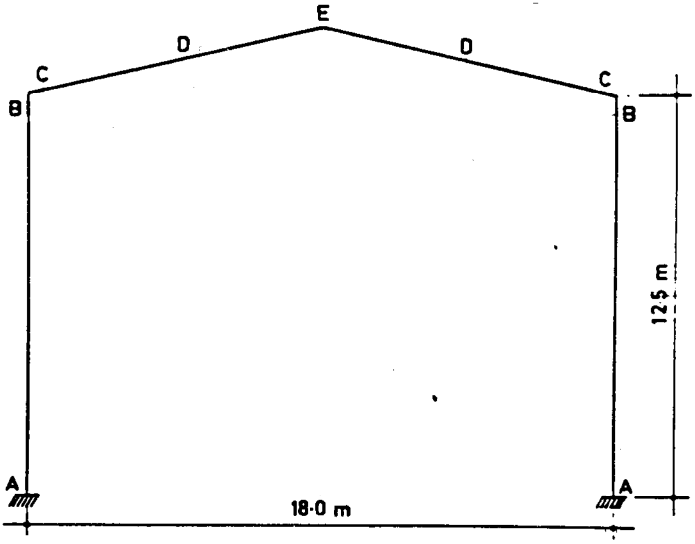
Design Ultimate Forces :

Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	646	–	268	–
B	678	–	307	–
C	678	271	–	248
D	94	358	–	128
E	42	496	–	43

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
A	*DL*	229	234	–	59
	LL	73	52	–	20
	WL	202	–	32	62

TABLE 16 DESIGN FORCES



Span : 18.0 m

Frame spacing : 12.0 m

Column height : 12.5 m

Roof slopes : 1:3, 1:4, 1:5

Support condition : Fixed

Wind/seismic zones : All

Design Ultimate Forces :

Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	928	–	213	–
B	683	–	205	–
C	683	417	–	255
D	149	416	–	134
E	38	577	–	62

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	210	258	–	43
	LL	66	52	–	14
	WL	409	–	86	98

TABLE 17 DESIGN FORCES

Span : 24.0 m

Frame spacing : 6.0 m

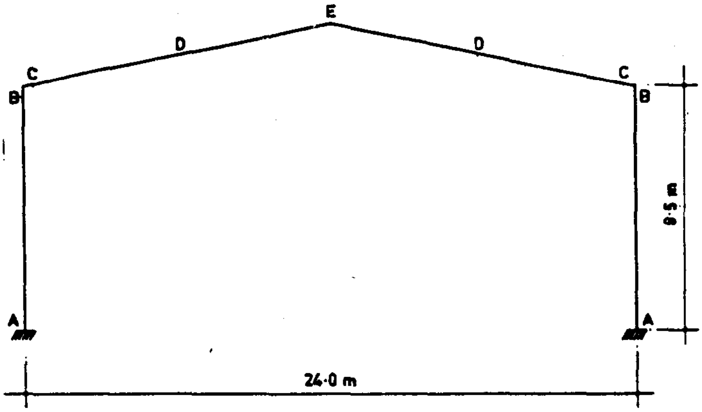
Column height : 9.5 m

Roof slopes : 1:3, 1:4, 1:5

Support condition : Fixed

Wind/seismic zones : All

Design Ultimate Forces :

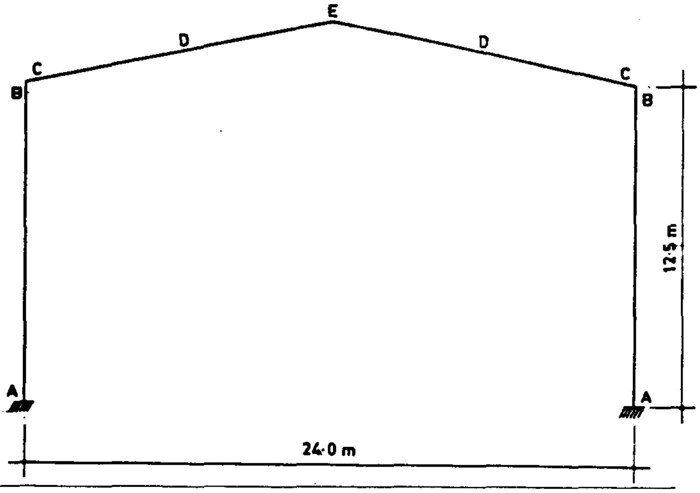


Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	724	–	377	–
B	989	–	334	–
C	989	–	–	260
D	–	440	–	129
E	–	592	–	24

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
A	*DL*	405	313	–	90
	LL	71	35	–	18
	WL	77	–	26	24

TABLE 18 DESIGN FORCES



Span	:	24.0 m
Frame spacing	:	6.0 m
Column height	:	12.5 m
Roof slopes	:	1:3, 1:4, 1:5
Support condition	:	Fixed
Wind/seismic zones	:	All
Design Ultimate Forces	:	

Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	826	–	423	–
B	982	–	334	–
C	982	9	–	269
D	–	515	–	138
E	–	712	–	26

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
	DL	378	350	–	73
A	*LL*	65	35	–	13
	WL	173	–	22	40

TABLE 19 DESIGN FORCES

Span : 24.0 m

Frame spacing : 12. 0 m

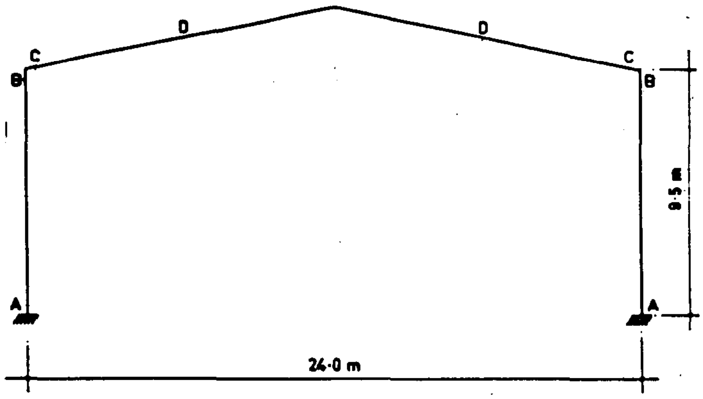
Column height : 9.5 m

Roof slopes : 1:3, 1:4, 1:5

Support condition : Fixed

Wind/seismic zones : All

Design Ultimate Forces :

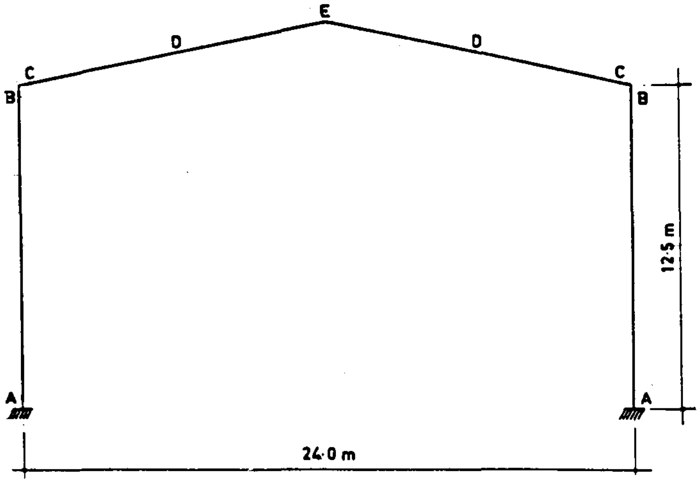


Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging *(kN.m)*	*Sagging* *(kN.m)*	*(kN)*	*(kN)*
A	1 062	–	444	–
B	1 450	–	489	–
C	1 450	197	–	381
D	47	645	–	189
E	–	868	–	40

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment* *(kN.m)*	*Axial Force*		*Shear Force* *(kN)*
			Compressive *(kN)*	*Tensile* *(kN)*	
A	*DL*	553	384	–	134
	LL	141	70	–	37
	WL	155	–	52	48

TABLE 20 DESIGN FORCES



Span : 24.0 m

Frame spacing : 12. 0 m

Column height : 12.5 m

Roof slopes : 1:3, 1:4, 1:5

Support condition : Fixed

Wind/seismic zones : All

Design Ultimate Forces :

Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	1 293	–	497	–
B	1 440	–	489	–
C	1 440	333	–	395
D	90	754	–	283
E	–	1 043	–	55

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	516	421	–	100
	LL	130	70	–	27
	WL	346	–	44	80

TABLE 21 DESIGN FORCES

Span : 30.0 m

Frame spacing : 6.0 m

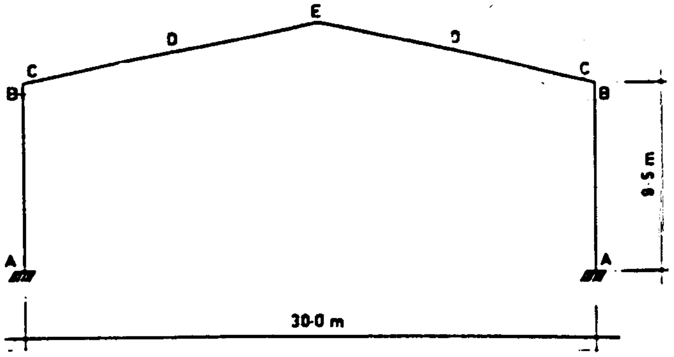
Column height : 9.5 m

Roof slopes : 1:3, 1:4, 1:5

Support condition : Fixed

Wind/seismic zones : All

Design Ultimate Forces :

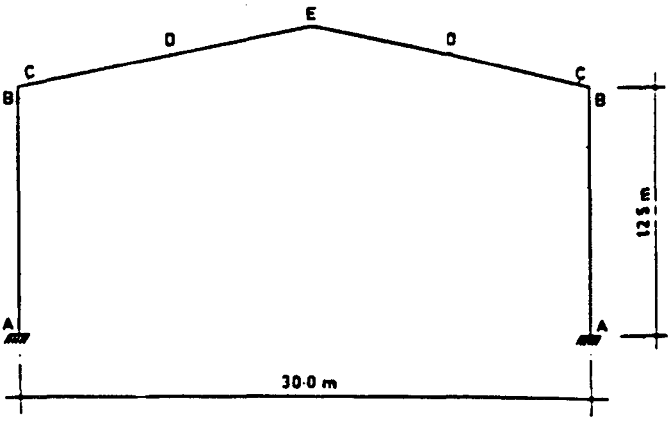


Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging *(kN.m)*	*Sagging* *(kN.m)*	*(kN)*	*(kN)*
A	1 141	–	542	–
B	1 523	–	417	–
C	1 523	–	–	313
D	–	600	–	150
E	–	765	–	43

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment* *(kN.m)*	*Axial Force*		*Shear Force* *(kN)*
			Compressive *(kN)*	*Tensile* *(kN)*	
A	*DL*	662	361	–	152
	LL	119	44	–	29
	WL	45	–	35	16

TABLE 22 DESIGN FORCES



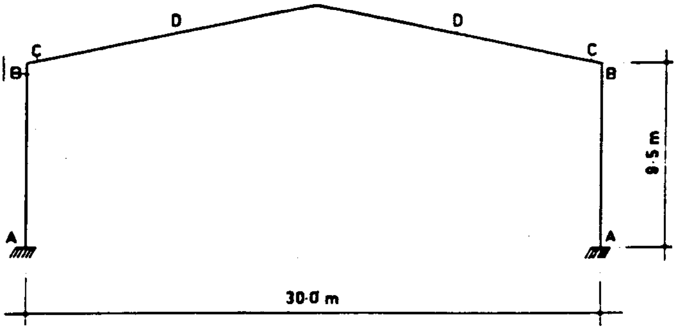
Span : 30.0 m
Frame spacing : 6.0 m
Column height : 12.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :

Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	1 155	–	480	–
B	1 547	–	417	–
C	1 547	–	–	327
D	–	707	–	164
E	–	959	–	28

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	627	398	–	117
	LL	109	44	–	22
	WL	143	–	32	34

TABLE 23 DESIGN FORCES



Span	:	30.0 m
Frame spacing	:	12. 0m
Column height	:	9.5 m
Roof slopes	:	1:3, 1:4, 1:5
Support condition	:	Fixed
Wind/seismic zones	:	All
Design Ultimate Forces	:	

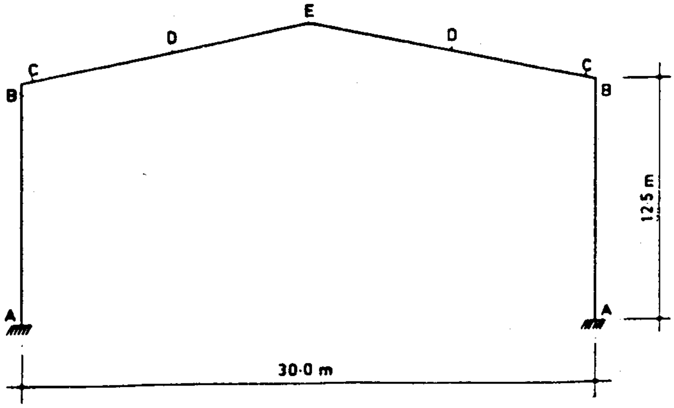
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	1 664	–	732	–
B	2 233	–	611	–
C	2 233	214	–	459
D	48	880	–	219
E	–	1 122	–	62

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
	DL	905	450	–	215
A	*LL*	237	87	–	59
	WL	90	–	70	32

TABLE 24 DESIGN FORCES

Span	: 30.0 m
Frame spacing	: 12.0 m
Column height	: 12.5 m
Roof slopes	: 1:3, 1:4, 1:5
Support condition	: Fixed
Wind/seismic zones	: All
Design Ultimate Forces	:



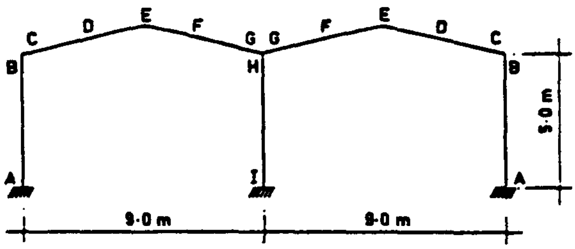
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	1 715	–	566	–
B	2 268	–	611	–
C	2 268	338	–	480
D	83	1 036	–	240
E	–	1 405	–	52

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
A	*DL*	857	487	–	159
	LL	218	87	–	43
	WL	286	–	64	67

TABLE 25 DESIGN FORCES

Span : 9.0 m
Frame spacing : 6.0 m
Column height : 5.0 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :



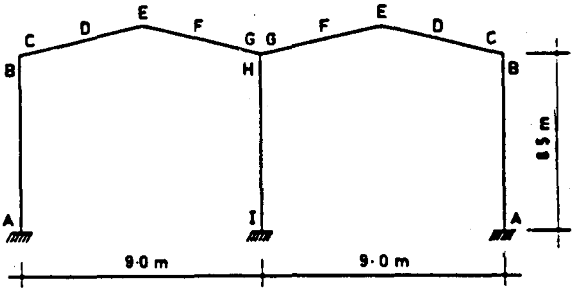
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	68	–	40	–
B	56	–	53	–
C	56	33	–	43
D	13	31	–	21
E	13	39	–	16
F	9	25	–	27
G	83	35	–	48
H	29	–	39	–
I	40	–	50	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
A	*DL*	20	46	–	9
	LL	9	12	–	5
	WL	26	–	4	14
I	*DL*	–	74	–	–
	LL	–	28	–	–
	WL	27	–	26	15

TABLE 26 DESIGN FORCES

Span : 9.0 m
Frame spacing : 6.0 m
Column height : 6.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :

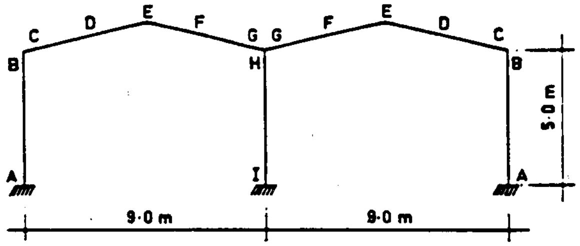


Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	99	–	36	–
B	70	–	39	–
C	70	40	–	48
D	13	40	–	23
E	10	49	–	19
F	8	39	–	33
G	101	29	–	58
H	50	–	56	–
I	64	–	78	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
	DL	20	57	–	7
A	*LL*	8	12	–	3
	WL	46	–	19	21
	DL	–	93	–	–
I	*LL*	–	28	–	–
	WL	43	–	26	19

TABLE 27 DESIGN FORCES



Span : 9.0 m
Frame spacing : 12.0 m
Column height : 5.0 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :

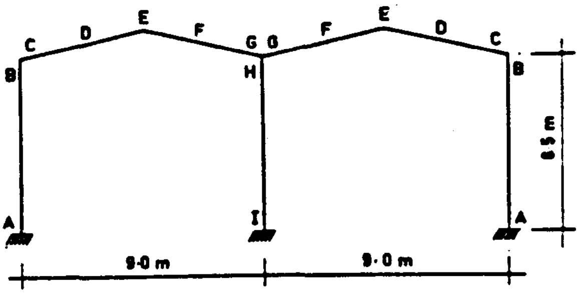
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	152	–	102	–
B	131	–	123	–
C	131	53	–	100
D	20	73	–	48
E	18	91	–	31
F	15	58	–	62
G	194	54	–	113
H	58	–	118	–
I	80	–	142	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	49	83	–	22
	LL	18	25	–	9
	WL	52	–	9	29
I	*DL*	–	155	–	–
	LL	–	55	–	–
	WL	54	–	51	29

TABLE 28 DESIGN FORCES

Span : 9.0 m
Frame spacing : 12.0 m
Column height : 6.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :



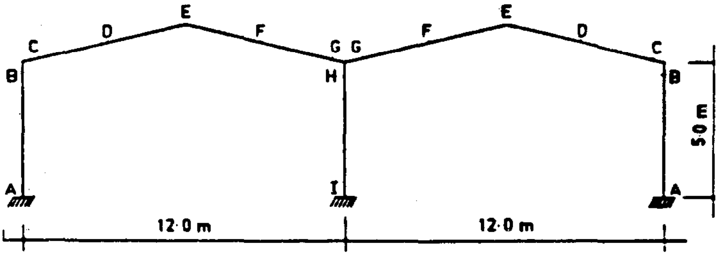
Section Designation	*Bending Moment* Hogging (kN.m)	Sagging (kN.m)	*Compressive Force* (kN)	*Shear Force* (kN)
A	201	–	64	–
B	143	–	82	–
C	143	78	–	100
D	25	83	–	48
E	18	102	–	38
F	15	69	–	68
G	209	54	–	119
H	99	–	112	–
I	129	–	153	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment* (kN.m)	*Axial Force* Compressive (kN)	Tensile (kN)	*Shear Force* (kN)
A	*DL*	42	88	–	16
	LL	16	24	–	6
	WL	92	–	37	42
I	*DL*	–	162	–	–
	LL	–	56	–	–
	WL	86	–	52	37

TABLE 29 DESIGN FORCES

Span	: 12.0 m
Frame spacing	: 6.0 m
Column height	: 5.0 m
Roof slopes	: 1:3, 1:4, 1:5
Support condition	: Fixed
Wind/seismic zones	: All
Design Ultimate Forces	:



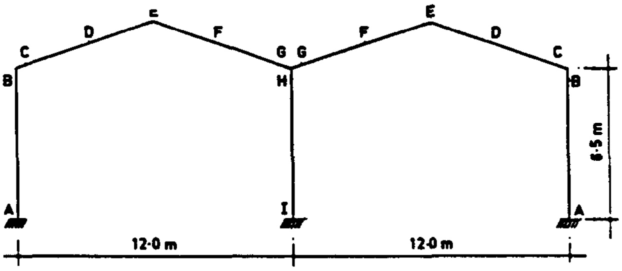
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	127	–	84	–
B	137	–	93	–
C	137	29	–	73
D	13	60	–	35
E	10	76	–	17
F	10	48	–	41
G	174	35	–	79
H	–	–	199	–
I	–	–	223	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
	DL	58	70	–	25
A	*LL*	19	17	–	9
	WL	27	–	8	14
	DL	–	149	–	–
I	*LL*	–	36	–	–
	WL	29	–	34	15

TABLE 30 DESIGN FORCES

Span : 12.0 m
Frame spacing : 6.0 m
Column height : 6.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :



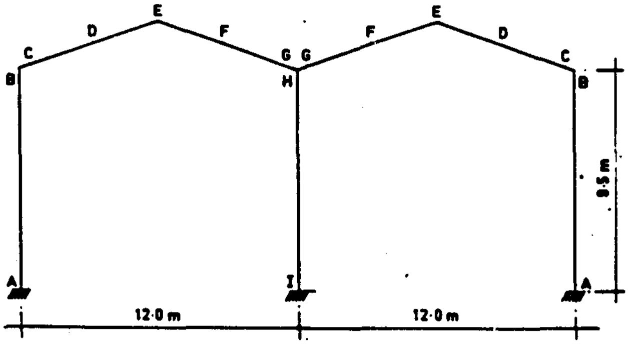
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	143	–	92	–
B	130	–	91	–
C	130	39	–	73
D	14	70	–	36
E	11	80	–	20
F	10	54	–	46
G	190	37	–	83
H	49	–	99	–
I	68	–	130	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	51	76	–	18
	LL	17	17	–	6
	WL	44	–	6	18
I	*DL*	–	129	–	–
	LL	–	37	–	–
	WL	46	–	34	19

TABLE 31 DESIGN FORCES

Span	: 12.0 m
Frame spacing	: 6.0 m
Column height	: 9.5 m
Roof slopes	: 1:3, 1:4, 1:5
Support condition	: Fixed
Wind/seismic zones	: All
Design Ultimate Forces	:



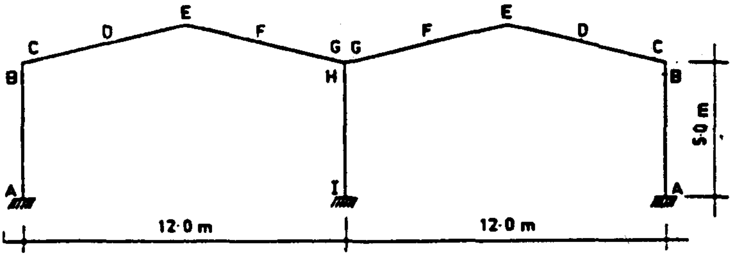
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	211	–	77	–
B	149	–	65	–
C	149	75	–	73
D	20	86	–	36
E	10	103	–	27
F	13	70	–	51
G	211	35	–	89
H	107	–	103	–
I	136	–	148	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
A	*DL*	41	88	–	11
	LL	13	16	–	4
	WL	100	–	24	31
I	*DL*	–	146	–	–
	LL	–	38	–	–
	WL	90	–	35	27

TABLE 32 DESIGN FORCES

Span : 12.0 m
Frame spacing : 12.0 m
Column height : 5.0 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :



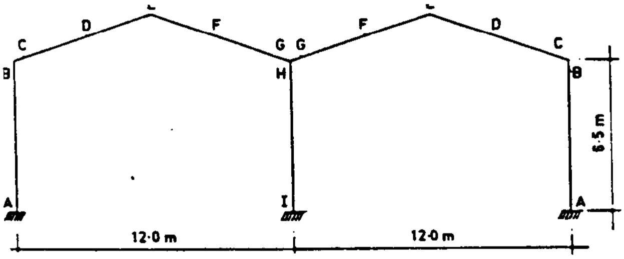
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	232	–	125	–
B	247	–	168	–
C	247	73	–	131
D	32	108	–	63
E	29	137	–	34
F	25	88	–	74
G	314	91	–	142
H	57	–	154	–
I	87	–	178	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	100	104	–	43
	LL	38	34	–	18
	WL	54	–	15	28
I	*DL*	–	193	–	–
	LL	–	72	–	–
	WL	58	–	67	30

TABLE 33 DESIGN FORCES

Span : 12.0 m
Frame spacing : 12.0 m
Column height : 6.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :

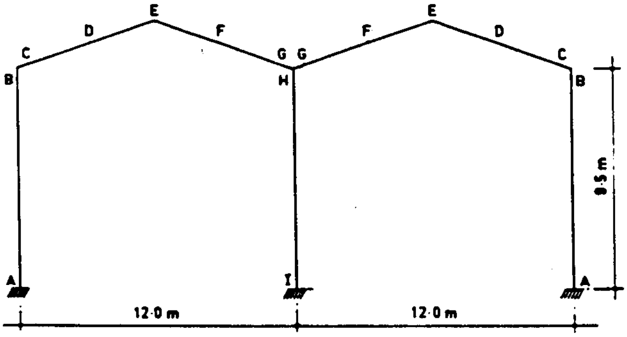


Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	265	–	134	–
B	234	–	165	–
C	234	92	–	133
D	36	127	–	64
E	32	189	–	40
F	26	101	–	82
G	344	95	–	150
H	97	–	158	–
I	137	–	189	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	89	110	–	31
	LL	33	33	–	12
	WL	88	–	12	37
I	*DL*	–	203	–	–
	LL	–	74	–	–
	WL	91	–	68	38

TABLE 34 DESIGN FORCES



Span : 12.0 m
Frame spacing : 12.0 m
Column height : 9.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :

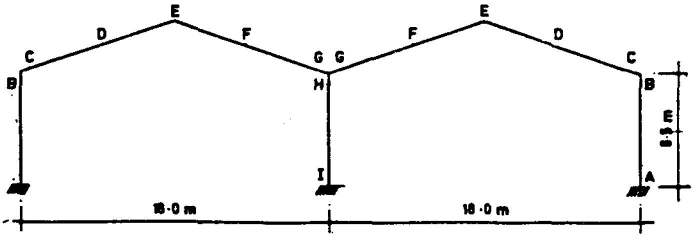
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	407	–	91	–
B	274	–	112	–
C	274	162	–	132
D	49	154	–	64
E	32	186	–	54
F	30	130	–	93
G	381	95	–	161
H	214	–	165	–
I	271	–	210	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
	DL	71	121	–	18
A	*LL*	26	32	–	7
	WL	201	–	47	63
	DL	–	222	–	–
I	*LL*	–	76	–	–
	WL	181	–	69	54

TABLE 35 DESIGN FORCES

Span : 18.0 m
Frame spacing : 6.0 m
Column height : 6.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :



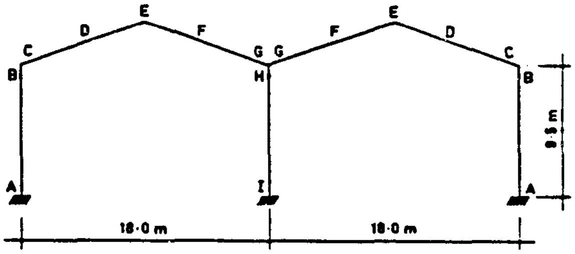
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging *(kN.m)*	*Sagging* *(kN.m)*	*(kN)*	*(kN)*
A	357	–	242	–
B	412	–	187	–
C	412	5	–	142
D	7	162	–	67
E	–	201	–	23
F	3	135	–	75
G	487	6	–	150
H	–	–	390	–
I	77	–	295	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive* *(kN)*	*Tensile* *(kN)*	*(kN)*
A	*DL*	198	156	–	63
	LL	47	26	–	16
	WL	47	–	12	18
I	*DL*	–	262	–	–
	LL	–	54	–	–
	WL	51	–	50	20

TABLE 36 DESIGN FORCES

Span : 18.0 m
Frame spacing : 6.0 m
Column height : 9.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :

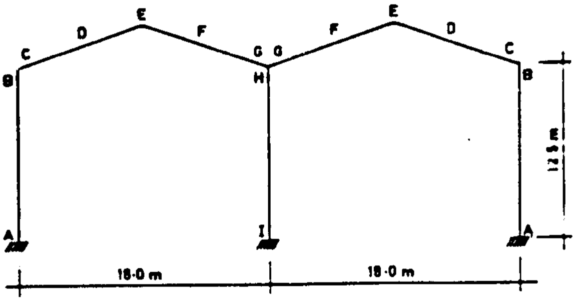


Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	394	–	217	–
B	388	–	181	–
C	388	27	–	145
D	3	206	–	70
E	–	258	–	28
F	3	154	–	89
G	560	–	–	164
H	104	–	246	–
I	147	–	326	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	168	177	–	40
	LL	38	25	–	10
	WL	95	–	9	27
I	*DL*	–	291	–	–
	LL	–	55	–	–
	WL	98	–	51	28

TABLE 37 DESIGN FORCES



Span : 18.0 m
Frame spacing : 6.0 m
Column height : 12.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :

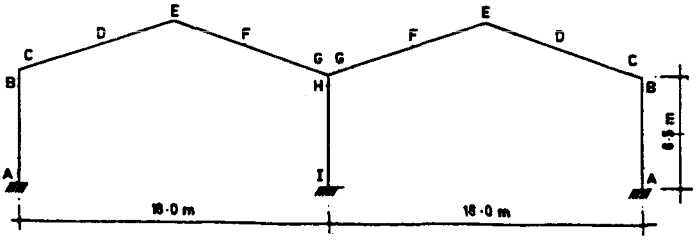
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	467	–	196	–
B	396	–	139	–
C	396	18	–	145
D	5	239	–	71
E	–	292	–	35
F	3	176	–	98
G	606	–	–	173
H	184	–	253	–
I	240	–	358	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	144	199	–	27
	LL	32	24	–	7
	WL	168	–	38	40
I	*DL*	–	320	–	–
	LL	–	56	–	–
	WL	160	–	52	36

TABLE 38 DESIGN FORCES

Span : 18.0 m
Frame spacing : 12.0 m
Column height : 6.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :

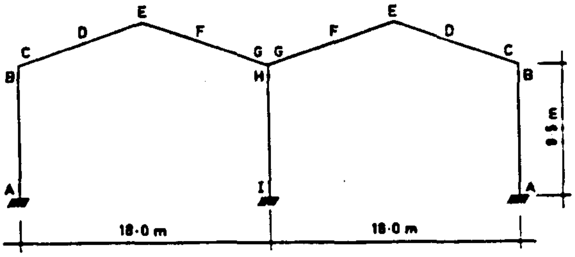


Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	591	–	253	–
B	664	–	301	–
C	664	106	–	228
D	45	260	–	108
E	28	323	–	45
F	37	218	–	121
G	784	124	–	241
H	–	–	628	–
I	154	–	380	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
	DL	299	209	–	95
A	*LL*	93	51	–	32
	WL	95	–	25	35
	DL	–	369	–	–
I	*LL*	–	107	–	–
	WL	103	–	100	39

TABLE 39 DESIGN FORCES



Span : 18.0 m
Frame spacing : 12.0 m
Column height : 9.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :

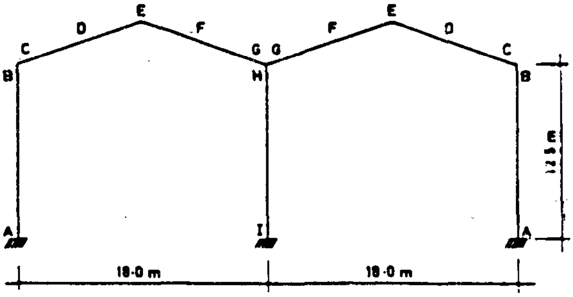
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	665	–	281	–
B	625	–	292	–
C	625	144	–	234
D	49	332	–	113
E	33	416	–	58
F	38	256	–	144
G	903	131	–	264
H	208	–	335	–
I	294	–	415	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
A	*DL*	254	229	–	60
	LL	75	50	–	19
	WL	189	–	19	54
I	*DL*	–	401	–	–
	LL	–	110	–	–
	WL	196	–	102	55

TABLE 40 DESIGN FORCES

Span : 18.0 m
Frame spacing : 12.0 m
Column height : 12.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :



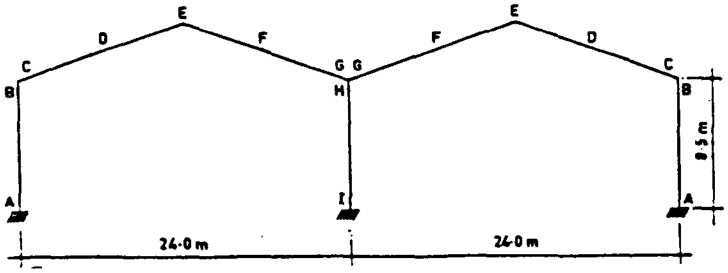
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	828	–	214	–
B	646	–	207	–
C	646	244	–	234
D	60	384	–	114
E	31	470	–	71
F	38	299	–	158
G	977	128	–	278
H	367	–	342	–
I	480	–	449	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	217	249	–	41
	LL	64	49	–	13
	WL	335	–	76	79
I	*DL*	–	433	–	–
	LL	–	112	–	–
	WL	320	–	104	71

TABLE 41 DESIGN FORCES

Span : 24.0 m
Frame spacing : 6.0 m
Column height : 9.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :



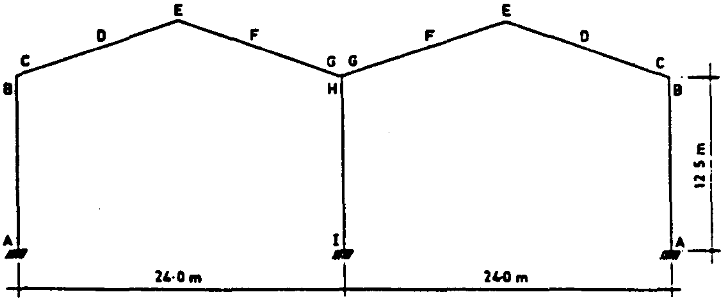
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	862	–	389	–
B	954	–	324	–
C	954	–	–	250
D	–	400	–	119
E	–	503	–	32
F	–	319	–	137
G	1 179	–	–	268
H	–	–	686	–
I	–	–	811	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
A	*DL*	476	310	–	105
	LL	79	34	–	19
	WL	99	–	16	26
I	*DL*	–	510	–	–
	LL	–	72	–	–
	WL	106	–	67	28

TABLE 42 DESIGN FORCES

Span : 24. 0 m
Frame spacing : 6.0 m
Column height : 12.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :



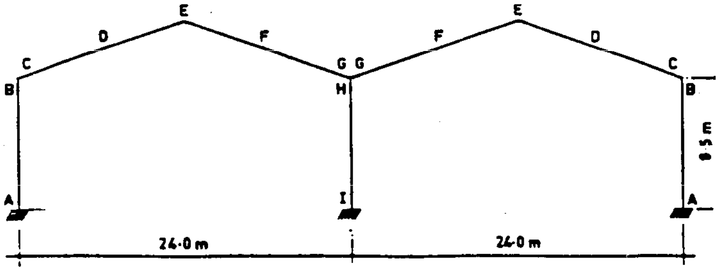
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	875	–	427	–
B	908	–	317	–
C	908	–	–	254
D	–	476	–	123
E	–	598	–	33
F	–	346	–	155
G	1 301	–	–	286
H	180	–	497	–
I	255	–	662	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
A	*DL*	420	344	–	75
	LL	68	33	–	13
	WL	164	–	13	35
I	*DL*	–	556	–	–
	LL	–	73	–	–
	WL	170	–	68	36

TABLE 43 DESIGN FORCES

Span : 24.0 m
Frame spacing : 12.0 m
Column height : 9.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :

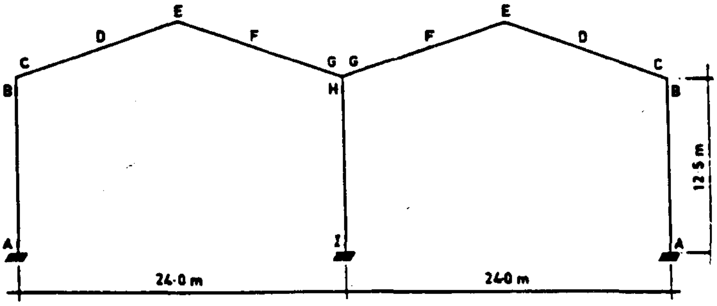


Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	1 271	–	471	–
B	1 399	–	475	–
C	1 399	52	–	366
D	32	587	–	174
E	–	737	–	59
F	22	474	–	201
G	1 720	57	–	393
H	–	–	1 005	–
I	319	–	724	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	650	381	–	144
	LL	158	68	–	38
	WL	198	–	31	52
I	*DL*	–	654	–	–
	LL	–	144	–	–
	WL	213	–	134	57

TABLE 44 DESIGN FORCES



Span : 24.0 m
Frame spacing : 12.0 m
Column height : 12.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :

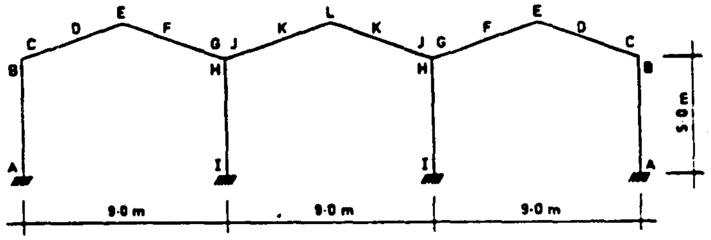
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	1 352	–	512	–
B	1 331	–	465	–
C	1 331	121	–	372
D	26	698	–	180
E	–	877	–	73
F	22	526	–	228
G	1 908	48	–	419
H	359	–	615	–
I	511	–	780	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
	DL	574	413	–	103
A	*LL*	135	66	–	26
	WL	328	–	26	71
	DL	–	702	–	–
I	*LL*	–	147	–	–
	WL	340	–	136	73

TABLE 45 DESIGN FORCES

Span : 9.0 m
Frame spacing : 6.0 m
Column height : 5.0 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :

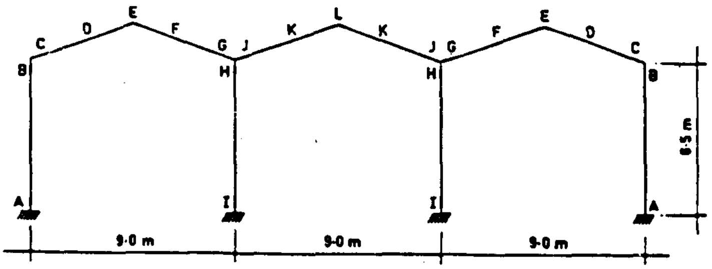


Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	69	–	40	–
B	60	–	54	–
C	60	30	–	43
D	13	29	–	21
E	13	39	–	15
F	10	24	–	25
G	77	33	–	47
H	36	–	93	–
I	45	–	104	–
J	78	33	–	47
K	9	25	–	24
L	10	31	–	9

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	23	47	–	10
	LL	10	13	–	5
	WL	24	–	5	12
I	*DL*	3	73	–	1
	LL	1	27	–	–
	WL	28	12	–	14

TABLE 46 DESIGN FORCES



Span	:	9.0 m
Frame spacing	:	6.0 m
Column height	:	6.5 m
Roof slopes	:	1:3, 1:4, 1:5
Support condition	:	Fixed
Wind/seismic zones	:	All
Design Ultimate Forces	:	

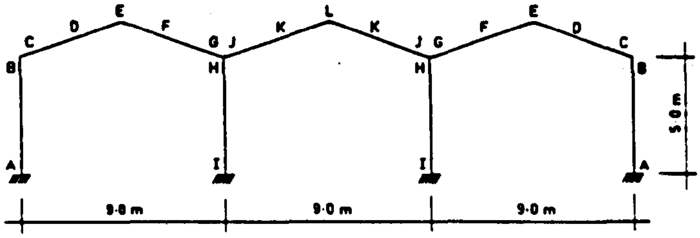
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	93	–	35	–
B	66	–	38	–
C	66	35	–	49
D	11	39	–	24
E	10	50	–	18
F	8	31	–	31
G	94	27	–	56
H	51	–	73	–
I	62	–	132	–
J	99	27	–	56
K	7	32	–	30
L	8	38	–	12

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
	DL	23	58	–	8
A	*LL*	9	12	–	3
	WL	39	–	20	17
	DL	2	90	–	–
I	*LL*	1	27	–	–
	WL	39	12	–	16

TABLE 47 DESIGN FORCES

Span	: 9.0 m
Frame spacing	: 12.0 m
Column height	: 5.0 m
Roof slopes	: 1:3, 1:4, 1:5
Support condition	: Fixed
Wind/seismic zones	: All
Design Ultimate Forces	:



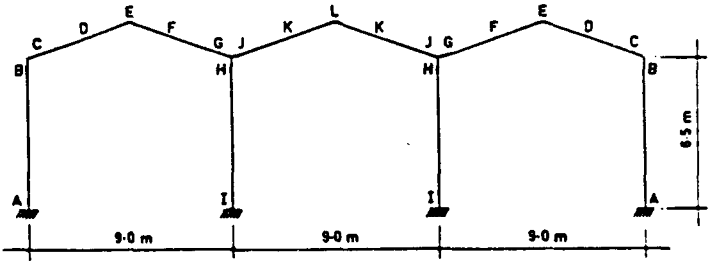
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	155	–	102	–
B	139	–	126	–
C	139	48	–	101
D	20	69	–	50
E	18	91	–	30
F	16	56	–	59
G	180	51	–	110
H	73	–	226	–
I	93	–	250	–
J	182	50	–	110
K	14	56	–	54
L	14	73	–	17

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	56	85	–	25
	LL	21	25	–	10
	WL	47	–	10	24
I	*DL*	6	149	–	2
	LL	1	53	–	1
	WL	55	24	–	28

TABLE 48 DESIGN FORCES

Span : 9.0 m
Frame spacing : 12.0 m
Column height : 6.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :



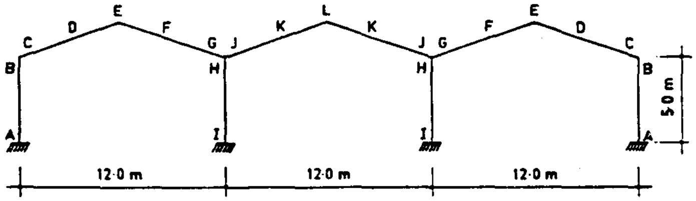
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	191	–	62	–
B	137	–	80	–
C	137	68	–	102
D	21	81	–	50
E	19	103	–	37
F	16	64	–	65
G	193	51	–	116
H	101	–	151	–
I	123	–	259	–
J	204	50	–	146
K	14	66	–	61
L	14	79	–	24

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	48	90	–	17
	LL	17	25	–	7
	WL	79	–	40	35
I	*DL*	3	157	–	1
	LL	1	54	–	–
	WL	79	24	–	33

TABLE 49 DESIGN FORCES

Span : 12.0 m
Frame spacing : 6.0 m
Column height : 5.0 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :



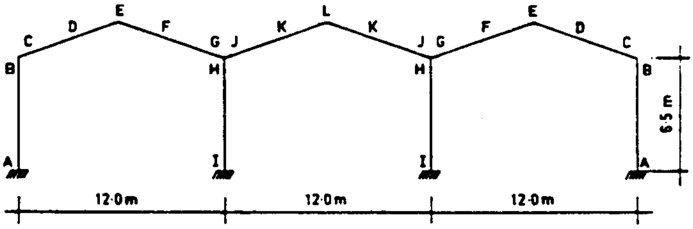
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	141	–	85	–
B	145	–	95	–
C	145	30	–	73
D	14	55	–	36
E	110	73	–	16
F	11	50	–	38
G	158	33	–	76
H	51	–	168	–
I	19	–	210	–
J	161	33	–	76
K	9	47	–	36
L	7	63	–	10

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	67	71	–	27
	LL	22	17	–	10
	WL	27	–	8	12
I	*DL*	10	119	–	3
	LL	3	35	–	1
	WL	36	16	–	17

TABLE 50 DESIGN FORCES

Span	:	12.0 m
Frame spacing	:	6.0 m
Column height	:	6.5 m
Roof slopes	:	1:3, 1:4, 1:5
Support condition	:	Fixed
Wind/seismic zones	:	All
Design Ultimate Forces	:	

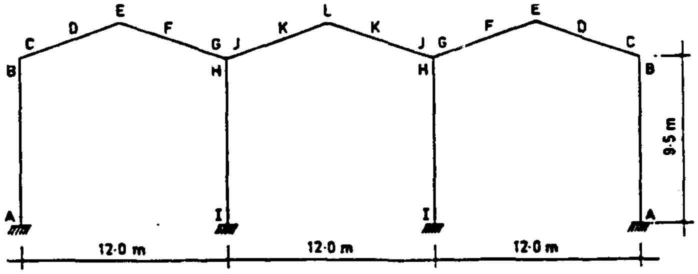


Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	149	–	92	–
B	138	–	93	–
C	138	34	–	75
D	13	67	–	37
E	11	88	–	20
F	11	54	–	43
G	175	34	–	81
H	63	–	170	–
I	82	–	201	–
J	177	34	–	81
K	10	53	–	40
L	8	71	–	10

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
	DL	59	77	–	20
A	*LL*	19	17	–	7
	WL	40	–	7	16
	DL	7	126	–	1
I	*LL*	2	36	–	–
	WL	48	16	–	19

TABLE 51 DESIGN FORCES



Span : 12.0 m
Frame spacing : 6.0 m
Column height : 9.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :

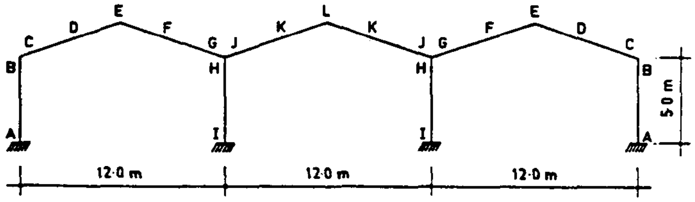
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	198	–	75	–
B	141	–	63	–
C	141	62	–	75
D	14	84	–	37
E	10	105	–	25
F	12	65	–	49
G	195	34	–	87
H	102	–	113	–
I	124	–	217	–
J	208	34	–	87
K	10	66	–	47
L	8	79	–	19

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	47	89	–	12
	LL	15	16	1	4
	WL	85	–	26	26
I	*DL*	3	142	–	–
	LL	1	36	–	–
	WL	80	16	–	23

TABLE 52 DESIGN FORCES

Span	: 12.0 m
Frame spacing	: 12.0 m
Column height	: 5.0 m
Roof slopes	: 1:3, 1:4, 1:5
Support condition	: Fixed
Wind/seismic zones	: All
Design Ultimate Forces	:



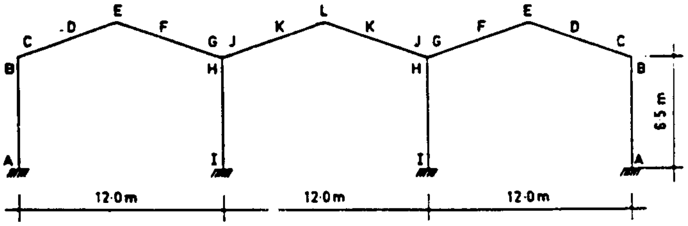
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	256	–	127	–
B	262	–	172	–
C	262	77	–	133
D	33	100	–	64
E	28	132	–	34
F	28	90	–	68
G	286	84	–	137
H	100	–	298	–
I	135	–	322	–
J	291	85	–	137
K	23	86	–	66
L	21	114	–	18

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
A	*DL*	116	107	–	47
	LL	44	35	–	19
	WL	55	–	16	25
I	*DL*	17	189	–	5
	LL	5	70	–	1
	WL	73	32	–	34

TABLE 53 DESIGN FORCES

Span : 12.0 m
Frame spacing : 12.0 m
Column height : 6.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :



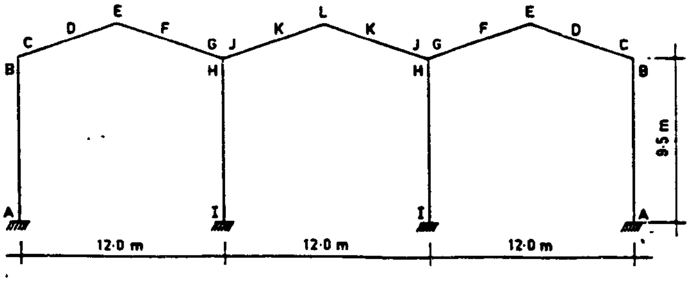
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	274	–	135	–
B	249	–	168	–
C	249	84	–	135
D	34	121	–	67
E	32	158	–	39
F	28	99	–	78
G	317	89	–	146
H	126	–	301	–
I	162	–	332	–
J	321	88	–	146
K	24	98	–	74
L	24	129	–	22

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
A	*DL*	103	112	–	34
	LL	38	34	–	14
	WL	80	–	14	31
I	*DL*	12	198	–	2
	LL	3	71	–	–
	WL	95	32	–	37

TABLE 54 DESIGN FORCES

Span : 12.0 m
Frame spacing : 12.0 m
Column height : 9.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :



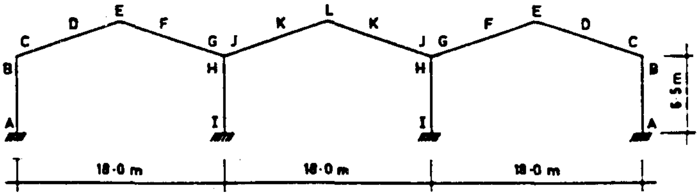
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	377	–	87	–
B	256	–	108	–
C	256	138	–	135
D	38	151	–	67
E	32	190	–	51
F	30	120	–	89
G	352	90	–	157
H	206	–	203	–
I	248	–	351	–
J	380	88	–	157
K	24	124	–	85
L	25	143	–	37

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	81	123	–	20
	LL	29	33	–	8
	WL	171	–	52	52
I	*DL*	4	214	–	–
	LL	1	72	–	–
	WL	161	32	–	47

TABLE 55 DESIGN FORCES

Span : 18.0 m
Frame spacing : 6.0 m
Column height : 6.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :

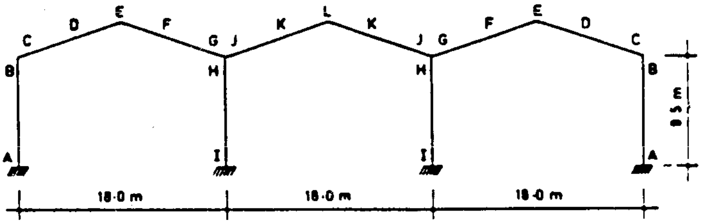


Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	410	–	246	–
B	436	–	191	–
C	436	5	–	143
D	15	1146	–	68
E	–	191	–	29
F	3	145	–	69
G	438	6	–	143
H	110	–	346	–
I	164	–	401	–
J	455	6	–	143
K	4	126	–	66
L	–	163	–	26

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	228	158	–	69
	LL	54	26	–	18
	WL	51	–	12	17
I	*DL*	37	259	–	8
	LL	8	52	–	2
	WL	73	24	–	25

TABLE 56 DESIGN FORCES



Span : 18.0 m

Frame spacing : 6.0 m

Column height : 9.5 m

Roof slopes : 1:3, 1:4, 1:5

Support condition : Fixed

Wind/seismic zones : All

Design Ultimate Forces :

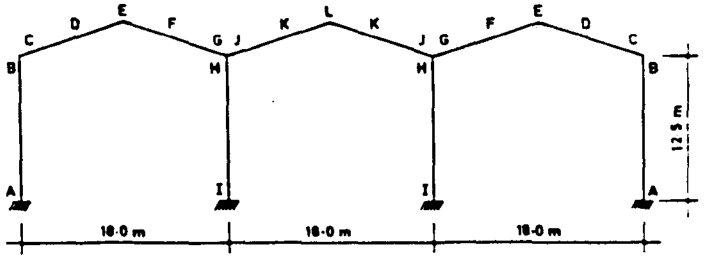
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	422	–	219	–
B	413	–	185	–
C	413	13	–	148
D	6	194	–	73
E	–	256	–	27
F	2	157	–	84
G	516	2	–	159
H	143	–	350	–
I	193	–	430	–
J	519	2	–	159
K	3	148	–	79
L	–	208	–	15

Foundation Forces at Service Load Stage

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	195	179	–	44
	LL	43	25	–	11
	WL	87	–	11	23
I	*DL*	24	289	–	3
	LL	3	53	–	–
	WL	104	24	–	28

TABLE - 57 DESIGN FORCES

Span : 18.0 m
Frame spacing : 6.0 m
Column height : 12.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :



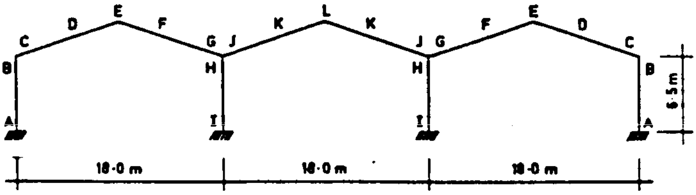
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	462	–	195	–
B	395	–	139	–
C	395	57	–	148
D	–	231	–	74
E	–	295	–	34
F	2	174	–	93
G	561	–	–	168
H	190	–	227	–
I	243	–	459	–
J	571	–	–	168
K	3	168	–	87
L	–	228	–	23

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	165	201	–	30
	LL	36	25	–	7
	WL	143	–	41	33
I	*DL*	13	312	–	1
	LL	1	54	–	–
	WL	149	24	–	32

TABLE 58 DESIGN FORCES

Span	:	18.0 m
Frame spacing	:	12.0 m
Column height	:	6.5 m
Roof slopes	:	1:3, 1:4, 1:5
Support condition	:	Fixed
Wind/seismic zones	:	All
Design Ultimate Forces	:	



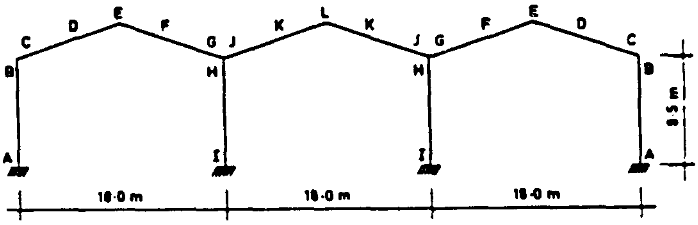
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	669	–	258	–
B	703	–	307	–
C	703	111	–	231
D	57	235	–	110
E	26	308	–	48
F	40	234	–	110
G	706	115	–	231
H	209	–	540	–
I	301	–	595	–
J	733	117	–	231
K	34	207	–	109
L	18	267	–	41

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
A	*DL*	344	212	–	104
	LL	108	52	–	35
	WL	103	–	25	33
I	*DL*	56	365	–	12
	LL	15	105	–	3
	WL	145	47	–	51

TABLE 59 DESIGN FORCES

Span	: 18.0 m
Frame spacing	: 12.0 m
Column height	: 9.5 m
Roof slopes	: 1:3, 1:4, 1:5
Support condition	: Fixed
Wind/seismic zones	: All
Design Ultimate Forces	:



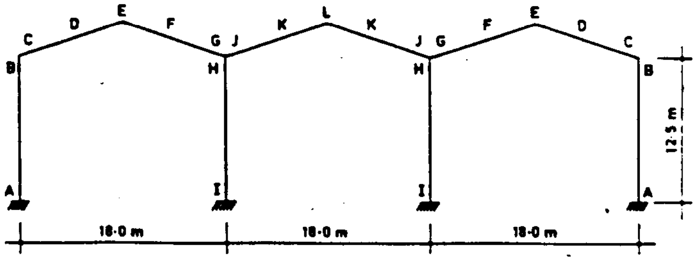
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	702	–	283	–
B	665	–	298	–
C	665	123	–	238
D	50	313	–	117
E	33	412	–	56
F	41	256	–	136
G	831	124	–	256
H	280	–	547	–
I	367	–	627	–
J	840	123	–	256
K	36	248	–	126
L	24	337	–	31

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	295	232	–	67
	LL	86	51	–	21
	WL	173	–	21	42
I	*DL*	37	393	–	5
	LL	7	106	–	1
	WL	208	48	–	55

TABLE 60 DESIGN FORCES

Span : 18.0 m
Frame spacing : 12.0 m
Column height : 12.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :



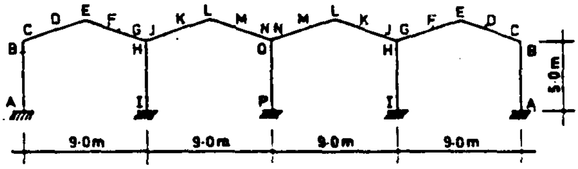
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	803	–	212	–
B	633	–	204	–
C	633	203	–	239
D	46	372	–	119
E	31	476	–	68
F	40	288	–	150
G	904	122	–	271
H	381	–	361	–
I	476	–	658	–
J	932	121	–	271
K	36	286	–	141
L	24	367	–	46

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	250	252	–	46
	LL	72	50	–	14
	WL	286	–	81	66
I	*DL*	20	420	–	1
	LL	2	108	–	–
	WL	298	48	–	64

TABLE 61 DESIGN FORCES

Span	:	9.0 m
Frame spacing	:	6.0 m
Column height	:	5.0 m
Roof slopes	:	1:3. 1:4. 1:5
Support condition	:	Fixed
Wind/seismic zones	:	All
Design Ultimate Forces	:	



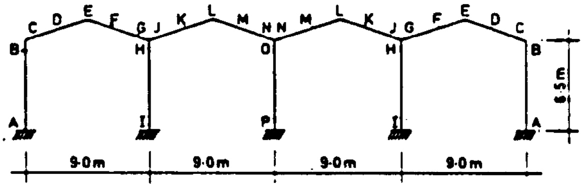
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	72	–	41	–
B	62	–	54	–
C	62	28	–	44
D	12	28	–	22
E	13	38	–	15
F	11	25	–	24
G	74	32	–	46
H	38	–	93	–
I	49	–	104	–
J	77	33	–	46
K	8	23	–	23
L	10	30	–	8
M	10	23	–	23
N	75	30	–	43
O	22	–	98	–
P	30	–	61	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
	DL	25	47	–	11
A	*LL*	12	13	–	5
	WL	23	–	5	11
	DL	6	73	–	2
I	*LL*	2	27	–	1
	WL	26	12	–	13
	DL	–	71	–	–
P	*LL*	–	26	–	–
	WL	20	–	16	10

TABLE 62 DESIGN FORCES

Span : 9.0 m
Frame spacing : 6.0 m
Column height : 6.5 m
Roof slopes : 1:3. 1:4. 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :



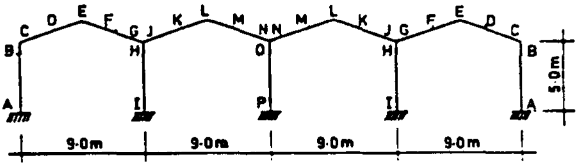
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	92	–	35	–
B	66	–	38	–
C	66	31	–	49
D	11	38	–	25
E	10	49	–	18
F	9	31	–	31
G	92	27	–	55
H	49	–	109	–
I	61	–	131	–
J	98	27	–	55
K	7	30	–	29
L	8	39	–	12
M	8	29	–	28
N	94	25	–	51
O	36	–	114	–
P	45	–	87	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
	DL	26	59	–	9
A	*LL*	10	13	–	4
	WL	36	–	21	16
	DL	5	91	–	1
I	*LL*	1	27	–	–
	WL	35	12	–	14
	DL	–	88	–	–
P	*LL*	–	26	–	–
	WL	30	–	15	12

TABLE 63 DESIGN FORCES

Span	: 9.0 m
Frame spacing	: 12.0 m
Column height	: 5.0 m
Roof slopes	: 1:3. 1:4. 1:5
Support condition	: Fixed
Wind/seismic zones	: All
Design Ultimate Forces	:



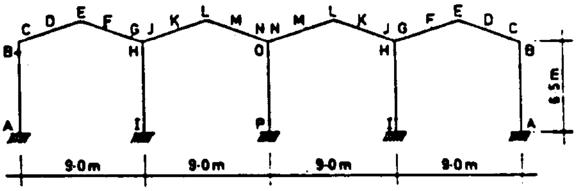
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging *(kN.m)*	*Sagging* *(kN.m)*	*(kN)*	*(kN)*
A	162	–	103	–
B	144	–	127	–
C	144	43	–	102
D	19	66	–	51
E	18	89	–	30
F	16	58	–	57
G	173	49	–	108
H	78	–	225	–
I	101	–	249	–
J	181	51	–	108
K	13	52	–	55
L	14	71	–	16
M	15	52	–	52
N	173	46	–	102
O	–	–	257	–
P	59	–	162	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive* *(kN)*	*Tensile* *(kN)*	*(kN)*
A	*DL*	62	85	–	26
	LL	23	26	–	10
	WL	46	–	10	22
I	*DL*	15	149	–	5
	LL	4	53	–	1
	WL	53	23	–	26
P	*DL*	–	146	–	–
	LL	–	52	–	–
	WL	39	–	31	20

TABLE 64 DESIGN FORCES

Span	: 9.0 m
Frame spacing	: 12.0 m
Column height	: 6.5 m
Roof slopes	: 1:3. 1:4. 1:5
Support condition	: Fixed
Wind/seismic zones	: All
Design Ultimate Forces	:



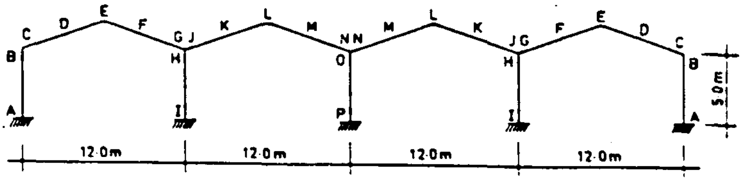
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	189	–	62	–
B	137	–	80	–
C	187	59	–	102
D	20	78	–	51
E	18	101	–	35
F	16	64	–	63
G	189	50	–	115
H	98	–	227	–
I	122	–	258	–
J	197	51	–	115
K	13	61	–	60
L	14	80	–	24
M	15	60	–	58
N	194	47	–	106
O	71	–	236	–
P	91	–	170	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
A	*DL*	53	91	–	18
	LL	19	25	–	7
	WL	73	–	41	31
I	*DL*	10	158	–	2
	LL	2	54	–	1
	WL	71	23	–	28
P	*DL*	–	154	–	–
	LL	–	51	–	–
	WL	60	–	31	25

TABLE 65 DESIGN FORCES

Span	: 12.0 m
Frame spacing	: 6.0 m
Column height	: 5.0 m
Roof slopes	: 1:3. 1:4. 1:5
Support condition	: Fixed
Wind/seismic zones	: All
Design Ultimate Forces	:



Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	153	–	87	–
B	151	–	96	–
C	151	31	–	74
D	16	51	–	36
E	9	71	–	17
F	11	52	–	36
G	149	31	–	74
H	60	–	167	–
I	38	–	211	–
J	164	34	–	74
K	9	42	–	36
L	6	52	–	14
M	10	46	–	34
N	149	30	–	70
O	–	–	189	–
P	–	–	213	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	73	72	–	29
	LL	25	18	–	10
	WL	29	–	8	12
I	*DL*	19	119	–	6
	LL	6	35	–	2
	WL	38	16	–	17
P	*DL*	–	117	–	–
	LL	–	34	–	–
	WL	23	–	21	11

TABLE 66 DESIGN FORCES

Span : 12.0 m

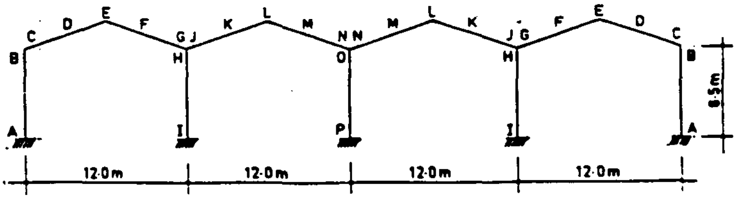
Frame spacing : 6.0 m

Column height : 6.5 m

Roof slopes : 1:3. 1:4. 1:5

Support condition : Fixed

Wind/seismic zones : All



Design Ultimate Forces :

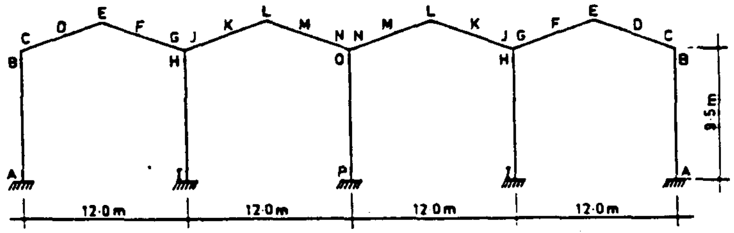
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	157	–	93	–
B	144	–	94	–
C	144	30	–	75
D	13	63	–	37
E	10	85	–	20
F	11	56	–	41
G	168	33	–	79
H	70	–	169	–
I	93	–	200	–
J	177	35	–	79
K	9	49	–	40
L	8	68	–	10
M	10	51	–	38
N	167	32	–	75
O	37	–	175	–
P	50	–	142	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
A	*DL*	66	78	–	21
	LL	21	17	–	7
	WL	39	–	7	15
I	*DL*	16	127	–	4
	LL	4	36	–	1
	WL	46	15	–	17
P	*DL*	–	124	–	–
	LL	–	34	–	–
	WL	34	–	21	13

TABLE 67 DESIGN FORCES

Span : 12.0 m
Frame spacing : 6. 0 m
Column height : 9.5 m
Roof slopes : 1:3. 1:4. 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :



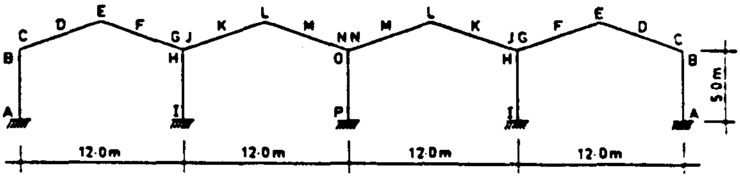
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	194	–	75	–
B	139	–	63	–
C	139	53	–	75
D	12	81	–	37
E	10	103	–	25
F	11	65	–	48
G	191	33	–	86
H	98	–	172	–
I	120	–	217	–
J	206	34	–	86
K	9	62	–	46
L	8	81	–	19
M	10	62	–	44
N	196	32	–	79
O	76	–	176	–
P	94	–	157	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	52	89	–	12
	LL	16	17	–	4
	WL	78	–	27	23
I	*DL*	9	142	–	1
	LL	2	36	–	–
	WL	71	15	–	20
P	*DL*	–	137	–	–
	LL	–	34	–	–
	WL	63	–	20	18

TABLE 68 DESIGN FORCES

Span	: 12.0 m
Frame spacing	: 12.0 m
Column height	: 5.0 m
Roof slopes	: 1:3. 1:4. 1:5
Support condition	: Fixed
Wind/seismic zones	: All
Design Ultimate Forces	:



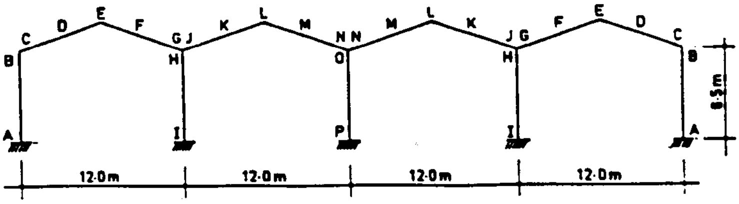
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	276	–	19	–
B	273	–	174	–
C	273	79	–	134
D	36	93	–	65
E	26	127	–	34
F	29	94	–	65
G	268	79	–	133
H	116	–	297	–
I	163	–	321	–
J	297	86	–	133
K	22	78	–	65
L	19	102	–	25
M	25	83	–	61
N	270	77	–	127
O	–	–	342	–
P	67	–	207	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
	DL	127	108	–	50
A	*LL*	49	35	–	21
	WL	57	–	16	24
	DL	34	190	–	10
I	*LL*	12	70	–	4
	WL	75	31	–	33
	DL	–	189	–	–
P	*LL*	–	69	–	–
	WL	45	–	42	21

TABLE 69 DESIGN FORCES

Span : 12.0 m
Frame spacing : 12.0 m
Column height : 6.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :



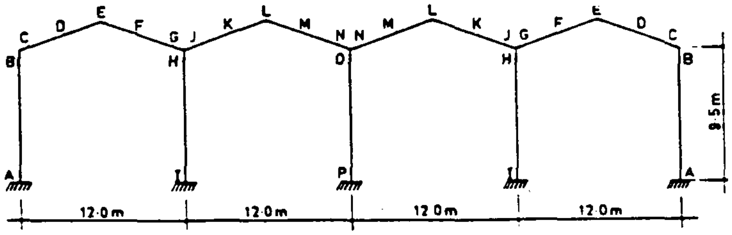
Section Designation	Bending Moment		Compressive Force	Shear Force
	Hogging (kN.m)	Sagging (kN.m)	(kN)	(kN)
A	289	–	136	–
B	259	–	170	–
C	259	76	–	136
D	34	114	–	68
E	31	154	–	39
F	29	97	–	75
G	303	86	–	143
H	137	–	300	–
I	119	–	331	–
J	320	90	–	143
K	23	91	–	73
L	24	123	–	21
M	26	92	–	69
N	304	82	–	135
O	74	–	313	–
P	101	–	215	–

Foundation Forces at Service Load Stage :

Section Designation	Forces Due to	Bending Moment (kN.m)	Axial Force		Shear Force (kN)
			Compressive (kN)	Tensile (kN)	
A	DL	114	113	–	37
	LL	42	34	–	14
	WL	79	–	14	29
I	DL	28	198	–	7
	LL	8	71	–	2
	WL	92	31	–	34
P	DL	–	194	–	–
	LL	–	69	–	–
	WL	67	–	41	26

TABLE 70 DESIGN FORCES

Span : 12.0 m
Frame spacing : 12.0 m
Column height : 9.5 m
Roof slopes : 1:3. 1:4. 1:5
Support condition : Fixed
Wind/seismic zones : All
Design Ultimate Forces :



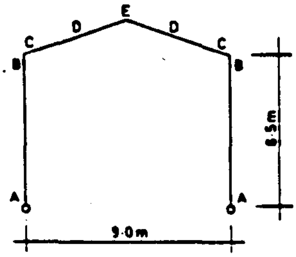
Section Designation	Bending Moment		Compressive Force	Shear Force
	Hogging (kN.m)	Sagging (kN.m)	(kN)	(kN)
A	368	–	86	–
B	252	–	106	–
C	252	120	–	136
D	34	147	–	68
E	32	187	–	50
F	28	119	–	87
G	346	89	–	155
H	194	–	304	–
I	237	–	349	–
J	375	90	–	155
K	24	115	–	83
L	25	146	–	36
M	26	114	–	80
N	359	83	–	142
O	151	–	315	–
P	188	–	231	–

Foundation Forces at Service Load Stage :

Section Designation	Forces Due to	Bending Moment	Axial Force		Shear Force
			Compressive	Tensile	
		(kN.m)	(kN)	(kN)	(kN)
A	DL	89	124	–	21
	LL	32	33	–	8
	WL	156	–	54	47
I	DL	16	215	–	2
	LL	3	73	–	1
	WL	142	31	–	40
P	DL	–	207	–	–
	LL	–	69	–	–
	WL	126	–	41	36

TABLE 71 DESIGN FORCES

Span	: 9.0 m
Frame spacing	: 6.0 m
Column height	: 5.0 m
Roof slopes	: 1:3, 1:4, 1:5
Support condition	: Hinged
Wind/seismic zones	: All
Design Ultimate Forces	:



Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	124	–
B	126	–	77	–
C	126	65	–	81
D	19	86	–	44
E	–	114	–	22

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
	DL	–	82	–	9
A	*LL*	–	13	–	2
	WL	–	–	1	17

TABLE 72 DESIGN FORCES

Span : 9.0 m

Frame spacing : 6.0 m

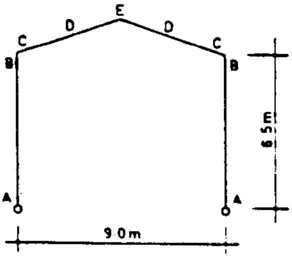
Column height : 6.5 m

Roof slopes : 1:3, 1:4, 1:5

Support condition : Hinged

Wind/seismic zones : All

Design Ultimate Forces :



Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	132	–
B	171	–	87	–
C	171	113	–	82
D	33	99	–	50
E	–	127	–	34

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	–	91	–	7
	LL	–	13	–	2
	WL	–	6	–	3

TABLE 73 DESIGN FORCES

Span : 9.0 m

Frame spacing :12.0 m

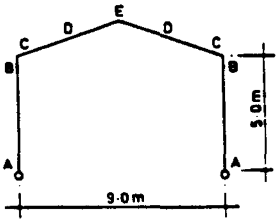
Column height : 5.0 m

Roof slopes : 1:3, 1:4, 1:5

Support condition : Hinged

Wind/seismic zones : All

Design Ultimate Forces :



Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	199	–
B	227	–	128	–
C	227	143	–	142
D	51	162	–	76
E	5	212	–	44

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	–	123	–	15
	LL	–	26	–	4
	WL	–	–	2	34

TABLE 74 DESIGN FORCES

Span : 9.0 m

Frame spacing : 12.0 m

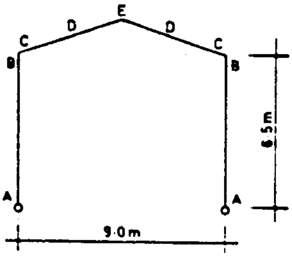
Column height : 6.5 m

Roof slopes : 1:3, 1:4, 1:5

Support condition : Hinged

Wind/seismic zones : All

Design Ultimate Forces :

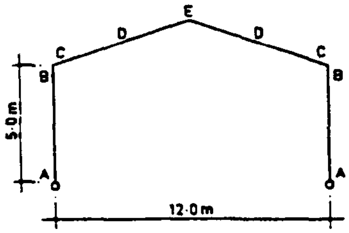


Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	209	–
B	319	–	149	–
C	319	241	–	144
D	80	181	–	90
E	–	235	–	66

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
	DL	–	133	–	10
A	*LL*	–	26	–	3
	WL	–	12	–	46

TABLE 75 DESIGN FORCES



Span : 12.0 m

Frame spacing : 6.0 m

Column height : 5.0 m

Roof slopes : 1:3, 1:4, 1:5

Support condition : Hinged

Wind/seismic zones : All

Design Ultimate Forces :

Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	185	–
B	205	–	111	–
C	205	48	–	120
D	9	140	–	63
E	–	190	–	19

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	–	122	–	22
	LL	–	18	–	5
	WL	–	–	8	15

TABLE 76 DESIGN FORCES

Span : 12.0 m

Frame spacing : 6.0 m

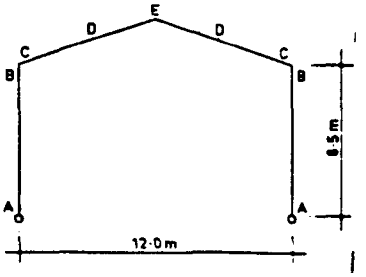
Column height : 6.5 m

Roof slopes : 1:3, 1:4, 1:5

Support condition : Hinged

Wind/seismic zones : All

Design Ultimate Forces :

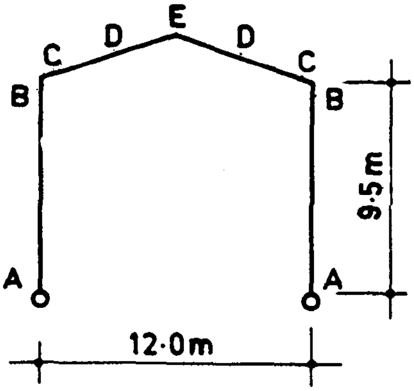


Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	197	–
B	247	–	119	–
C	247	95	–	122
D	22	160	–	66
E	–	216	–	29

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	–	135	–	16
	LL	–	18	–	3
	WL	–	–	2	21

TABLE 77 DESIGN FORCES



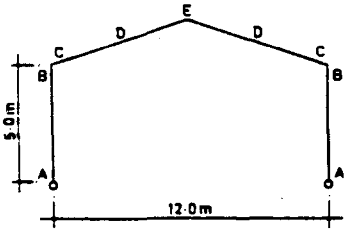
Span	:	12.0 m
Frame spacing	:	6.0 m
Column height	:	9.5 m
Roof slopes	:	1:3, 1:4, 1:5
Support condition	:	Hinged
Wind/seismic zones	:	All
Design Ultimate Forces	:	

Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	252	–
B	388	–	164	–
C	388	218	–	144
D	38	248	–	91
E	–	307	–	55

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
	DL	–	186	–	11
A	*LL*	–	18	–	2
	WL	–	12	–	40

TABLE 78 DESIGN FORCES



Span	: 12.0 m
Frame spacing	: 12.0 m
Column height	: 5.0 m
Roof slopes	: 1:3, 1:4, 1:5
Support condition	: Hinged
Wind/seismic zones	: All
Design Ultimate Forces	:

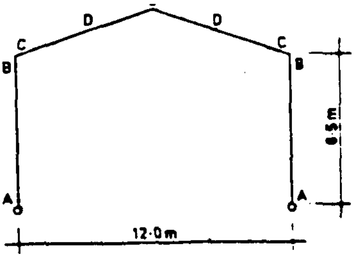
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	290	–
B	340	–	176	–
C	340	133	–	203
D	41	254	–	108
E	–	341	–	39

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
A	*DL*	–	179	–	34
	LL	–	35	–	9
	WL	–	–	15	30

TABLE 79 DESIGN FORCES

Span : 12.0 m
Frame spacing : 12.0 m
Column height : 6.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :

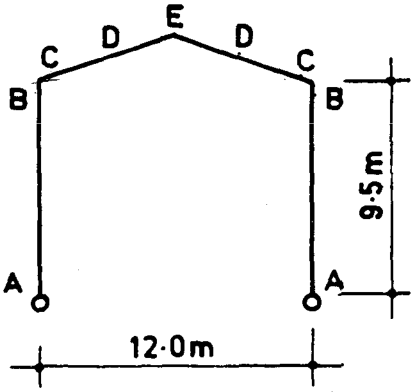


Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	303	–
B	426	–	192	–
C	426	226	–	207
D	71	291	–	111
E	–	386	–	57

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
	DL	–	194	–	25
A	*LL*	–	35	–	6
	WL	–	–	4	43

TABLE 80 DESIGN FORCES



Span : 12.0 m
Frame spacing : 12.0 m
Column height : 9.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :

Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	360	–
B	697	–	259	–
C	697	491	–	230
D	128	415	–	153
E	–	511	–	105

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
A	*DL*	–	249	–	15
	LL	–	35	–	4
	WL	–	25	–	38

TABLE 81 DESIGN FORCES

Span : 18.0 m

Frame spacing : 6.0 m

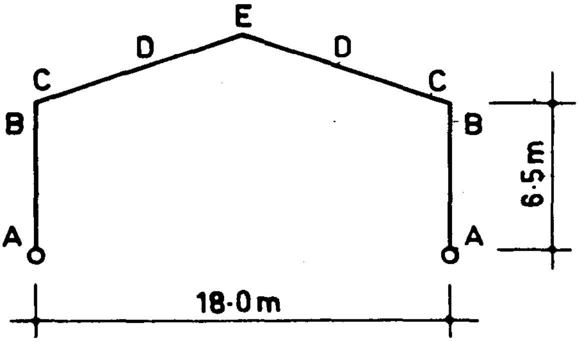
Column height : 6.5 m

Roof slopes : 1:3, 1:4, 1:5

Support condition : Hinged

Wind/seismic zones : All

Design Ultimate Forces :

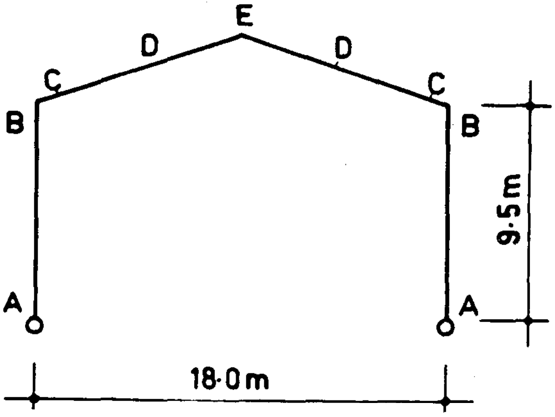


Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	289	–
B	480	–	234	–
C	480	51	–	192
D	–	324	–	100
E	–	439	–	23

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	–	191	–	41
	LL	–	26	–	8
	WL	–	–	14	17

TABLE 82 DESIGN FORCES



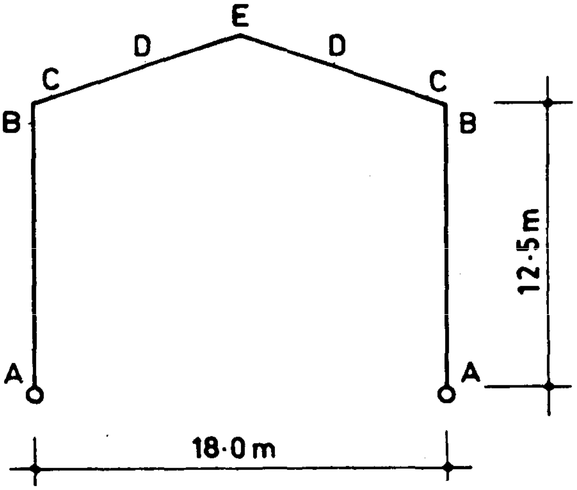
Span	:	18.0 m
Frame spacing	:	6.0 m
Column height	:	9.5 m
Roof slopes	:	1:3, 1:4, 1:5
Support condition	:	Hinged
Wind/seismic zones	:	All
Design Ultimate Forces	:	

Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging *(kN.m)*	*Sagging* *(kN.m)*	*(kN)*	*(kN)*
A	–	–	335	–
B	593	–	212	–
C	593	168	–	211
D	5	440	–	113
E	–	586	–	44

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive* *(kN)*	*Tensile* *(kN)*	*(kN)*
A	*DL*	–	234	–	28
	LL	–	26	–	5
	WL	–	–	4	31

TABLE 83 DESIGN FORCES



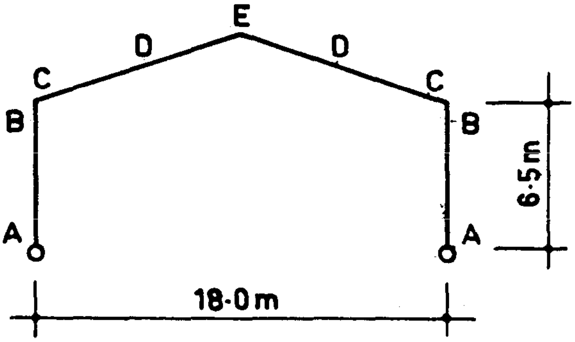
Span	:	18.0 m
Frame spacing	:	6.0 m
Column height	:	12.5 m
Roof slopes	:	1:3, 1:4, 1:5
Support condition	:	Hinged
Wind/seismic zones	:	All
Design Ultimate Forces	:	

Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	407	–
B	793	–	226	–
C	793	334	–	243
D	2	594	–	138
E	–	777	–	69

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
A	*DL*	–	301	–	21
	LL	–	26	–	3
	WL	–	9	–	44

TABLE 84 DESIGN FORCES



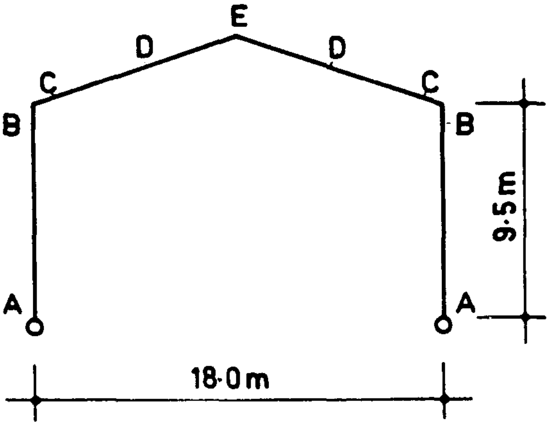
Span : 18.0 m
Frame spacing : 12. 0 m
Column height : 6.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :

Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	425	–
B	737	–	367	–
C	737	226	–	302
D	68	527	–	158
E	–	709	–	47

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
	DL	–	260	–	60
A	*LL*	–	52	–	16
	WL	–	–	28	35

TABLE 85 DESIGN FORCES



Span : 18.0 m

Frame spacing : 12.0 m

Column height : 9.5 m

Roof slopes : 1:3, 1:4, 1:5

Support condition : Hinged

Wind/seismic zones : All

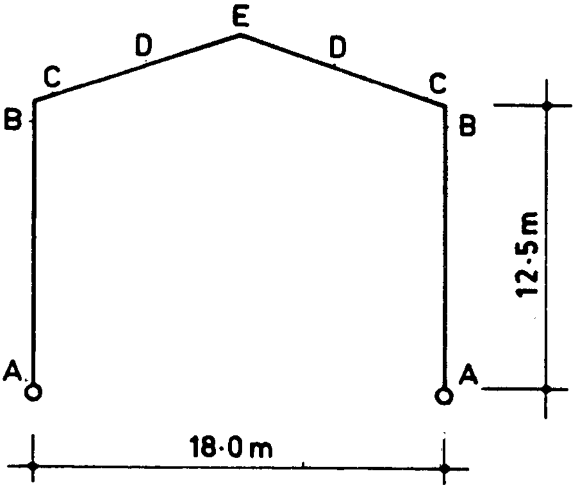
Design Ultimate Forces :

Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	493	–
B	978	–	319	–
C	978	451	–	339
D	111	745	–	182
E	–	981	–	84

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
	DL	–	322	–	40
A	*LL*	–	52	–	10
	WL	–	–	9	63

TABLE 86 DESIGN FORCES



Span : 18.0 m

Frame spacing : 12.0 m

Column height : 12.5 m

Roof slopes : 1:3, 1:4, 1:5

Support condition : Hinged

Wind/seismic zones : All

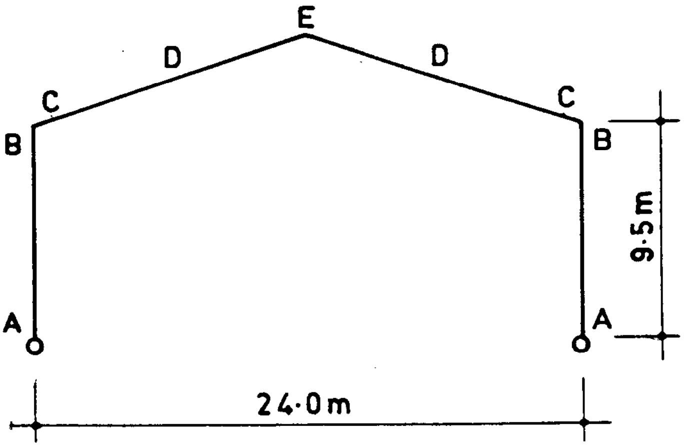
Design Ultimate Forces :

Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	589	–
B	1370	–	411	–
C	1370	797	–	387
D	135	1009	–	224
E	–	1296	–	132

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
A	*DL*	–	312	–	30
	LL	–	52	–	6
	WL	--	18	–	89

TABLE 87 DESIGN FORCES



Span : 24.0 m

Frame spacing : 6.0 m

Column height : 9.5 m

Roof slopes : 1:3, 1'4, 1:5

Support condition : Hinged

Wind/seismic zones : All

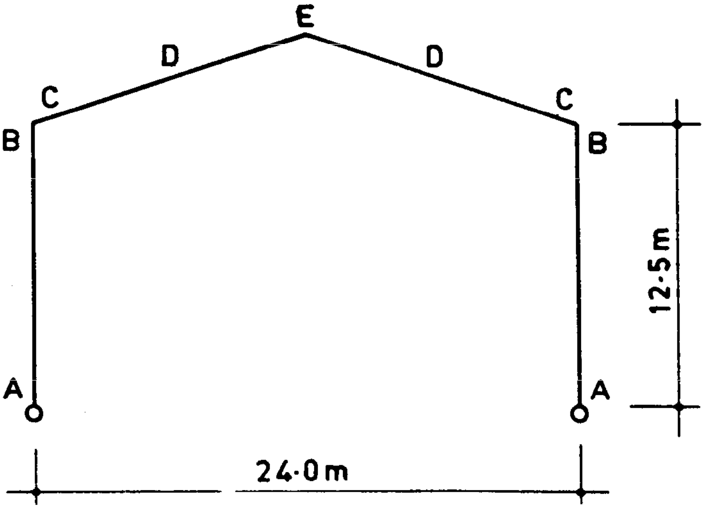
Design Ultimate Forces :

Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	522	–
B	1 095	–	339	–
C	1095	–	–	334
D	–	791	–	176
E	–	1069	–	37

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
A	*DL*	–	365	–	67
	LL	–	35	–	10
	WL	–	–	17	27

TABLE 88 DESIGN FORCES



Span : 24.0 m

Frame spacing : 6.0 m

Column height : 12.5 m

Roof slopes : 1:3, 1:4, 1:5

Support condition : Hinged

Wind/seismic zones : All

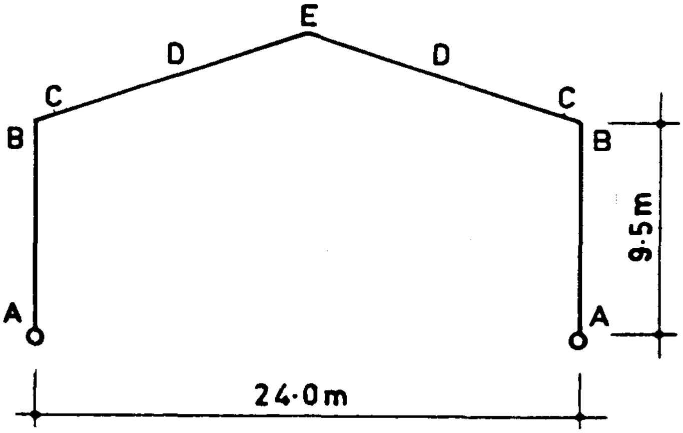
Design Ultimate Forces :

Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	593	–
B	1288	–	381	–
C	1288	146	–	363
D	–	1002	–	195
E	–	1335	–	60

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
A	*DL*	–	429	–	51
	LL	–	35	–	7
	WL	–	–	6	42

TABLE 89 DESIGN FORCES



Span : 24. 0 m

Frame spacing : 12.0 m

Column height : 9.5 m

Roof slopes : 1:3, 1:4, 1:5

Support condition : Hinged

Wind/seismic zones : All

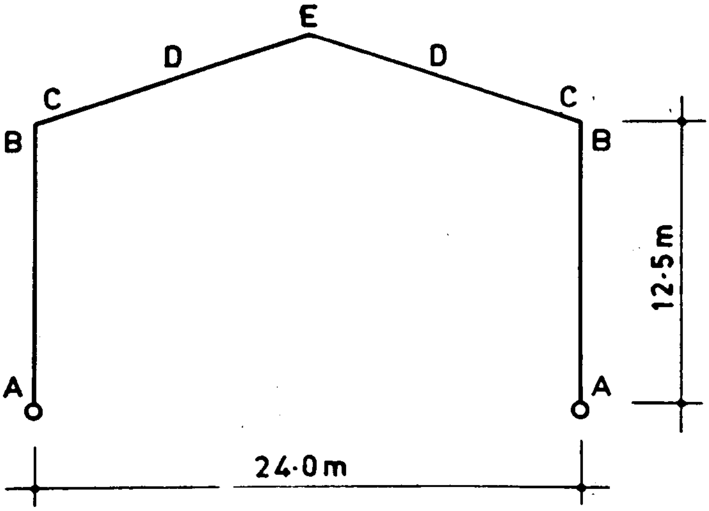
Design Ultimate Forces :

Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	708	–
B	1571	–	448	–
C	1571	329	–	485
D	32	1181	–	256
E	–	1588	–	73

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
A	*DL*	–	460	–	90
	LL	–	70	–	19
	WL	–	–	33	54

TABLE 90 DESIGN FORCES



Span : 24.0 m
Frame spacing : 12.0 m
Column height : 12.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :

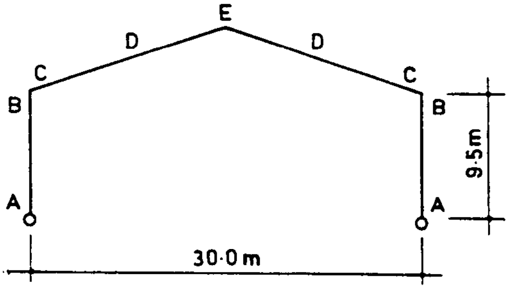
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	846	–
B	2024	–	560	–
C	2024	600	–	563
D	–	1662	–	302
E	–	2185	–	115

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
	DL	–	583	–	71
A	*LL*	–	70	–	13
	WL	–	–	13	82

TABLE 91 DESIGN FORCES

Span : 30.0 m
Frame spacing : 6.0 m
Column height : 9.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :



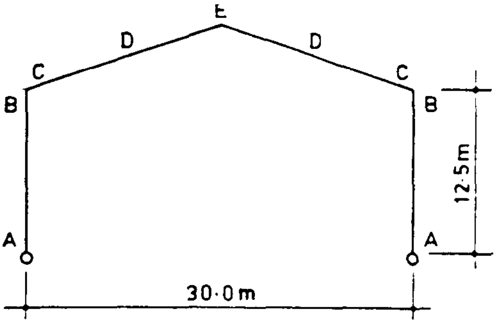
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	765	–
B	2153	–	596	–
C	2153	–	–	482
D	–	1194	–	248
E	–	1637	–	30

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
	DL	–	530	–	130
A	*LL*	–	44	–	17
	WL	–	–	27	22

TABLE 92 DESIGN FORCES

Span	: 30.0 m
Frame spacing	: 6.0 m
Column height	: 12.5 m
Roof slopes	: 1:3, 1:4, 1:5
Support condition	: Hinged
Wind/seismic zones	: All
Design Ultimate Forces	:



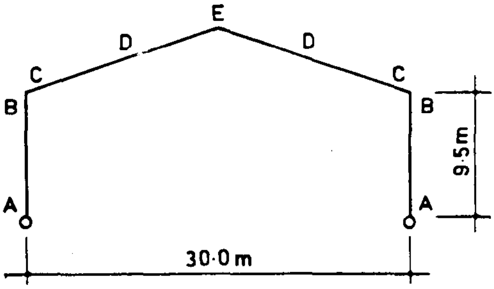
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	918	–
B	2347	–	606	–
C	2347	–	–	563
D	–	1676	–	297
E	–	2272	–	53

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
	DL	–	663	–	111
A	*LL*	–	44	–	12
	WL	–	–	19	36

TABLE 93 DESIGN FORCES

Span	: 30. 0 m
Frame spacing	: 12.0 m
Column height	: 9.5 m
Roof slopes	: 1:3, 1:4, 1:5
Support condition	: Hinged
Wind/seismic zones	: All
Design Ultimate Forces	:



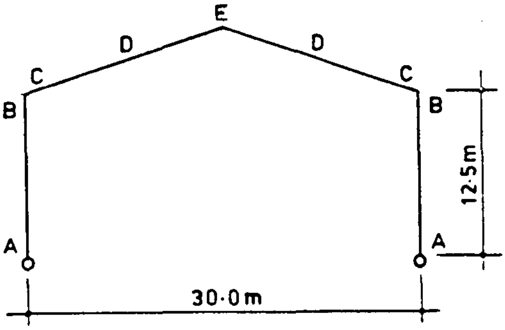
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	1050	–
B	3070	–	873	–
C	3070	–	–	707
D	–	1847	–	365
E	–	2506	–	64

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
	DL	–	694	–	182
A	*LL*	–	87	–	32
	WL	–	–	54	44

TABLE 94 DESIGN FORCES

Span	: 30.0 m
Frame spacing	: 12.0 m
Column height	: 12.5 m
Roof slopes	: 1:3, 1:4, 1:5
Support condition	: Hinged
Wind/seismic zones	: All
Design Ultimate Forces	:



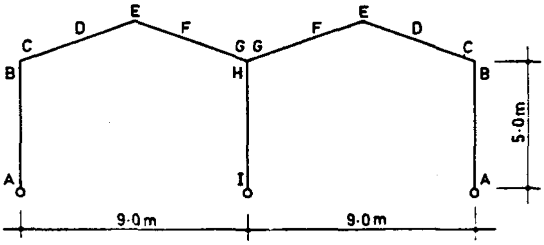
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	1207	–
B	3264	–	796	–
C	3264	163	–	795
D	–	2475	–	420
E	–	3324	–	101

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
	DL	–	832	–	146
A	*LL*	–	87	–	23
	WL	–	–	–	74

TABLE 95 DESIGN FORCES

Span : 9.0 m
Frame spacing : 6.0 m
Column height : 5.0 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :



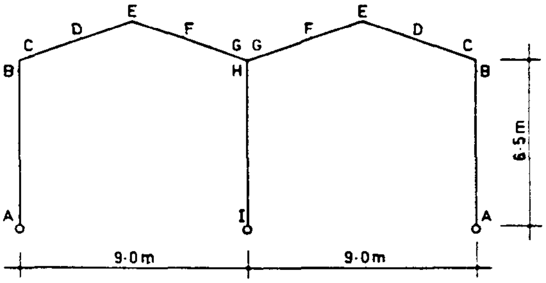
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	113	–
B	105	–	70	–
C	105	40	–	71
D	5	75	–	35
E	–	85	–	20
F	3	49	–	55
G	168	–	–	92
H	–	–	213	–
I	–	–	242	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	–	77	–	8
	LL	–	12	–	2
	WL	–	–	–	14
I	*DL*	–	145	–	–
	LL	–	29	–	–
	WL	–	6	–	13

TABLE 96 DESIGN FORCES

Span : 9.0 m
Frame spacing : 6.0 m
Column height : 6.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :



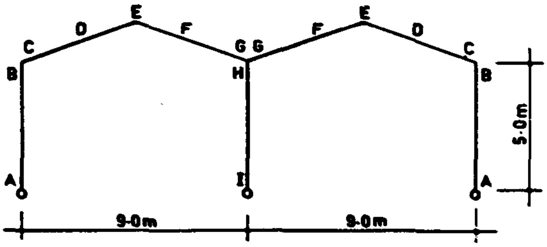
Section Designation	Bending Moment		Compressive Force	Shear Force
	Hogging (kN.m)	Sagging (kN.m)	(kN)	(kN)
A	–	–	119	–
B	130	–	75	–
C	130	72	–	70
D	12	82	–	41
E	–	90	–	26
F	11	59	–	58
G	194	8	–	95
H	121	–	136	–
I	–	–	254	–

Foundation Forces at Service Load Stage :

Section Designation	Forces Due to	Bending Moment (kN.m)	Axial Force		Shear Force (kN)
			Compressive (kN)	Tensile (kN)	
A	*DL*	–	85	–	5
	LL	–	11	–	1
	WL	–	5	–	17
I	*DL*	–	157	–	–
	LL	–	30	–	–
	WL	–	5	–	17

TABLE 97 DESIGN FORCES

Span : 9.0 m
Frame spacing : 12.0 m
Column height : 5.0 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :

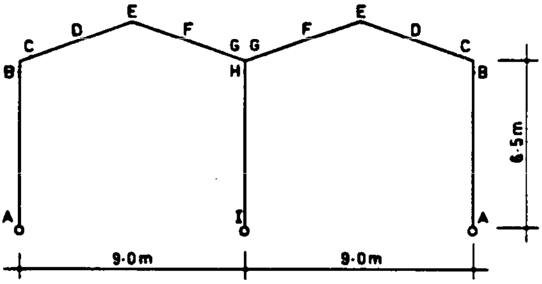


Section Designation	*Bending Moment*		**Compressive Force**	**Shear Force**
	Hogging *(kN.m)*	*Sagging* *(kN.m)*	*(kN)*	*(kN)*
A	–	–	178	–
B	186	–	118	–
C	186	90	–	122
D	19	138	–	62
E	4	153	–	40
F	11	91	–	98
G	298	21	–	164
H	150	–	211	–
I	–	–	408	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment* *(kN.m)*	***Axial Force***		***Shear Force*** ***(kN)***
			Compressive ***(kN)***	***Tensile*** ***(kN)***	
	DL	–	113	–	12
A	*LL*	–	23	–	3
	WL	–	1	–	26
	DL	–	231	–	–
I	*LL*	–	59	–	–
	WL	–	11	–	28

TABLE 98 DESIGN FORCES



Span : 9.0 m

Frame spacing : 12.0 m

Column height : 6.0 m

Roof slopes : 1:3, 1:4, 1:5

Support condition : Hinged

Wind/seismic zones : All

Design Ultimate Forces :

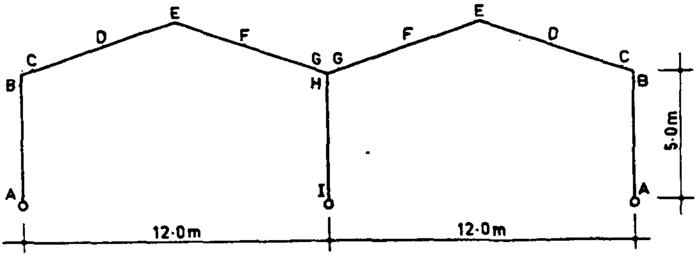
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	185	–
B	240	–	129	–
C	240	154	–	121
D	34	150	–	74
E	–	162	–	51
F	28	111	–	103
G	345	43	–	168
H	243	–	218	–
I	–	–	424	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	–	122	–	8
	LL	–	22	–	2
	WL	–	10	–	35
I	*DL*	–	245	–	–
	LL	–	60	–	–
	WL	–	8	–	35

TABLE 99 DESIGN FORCES

Span : 12.0 m
Frame spacing : 6.0 m
Column height : 5.0 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :



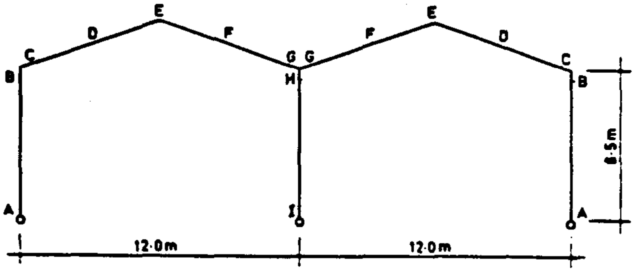
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	174	–
B	192	–	109	–
C	192	20	–	109
D	–	127	–	53
E	–	152	–	21
F	–	84	–	76
G	313	–	–	133
H	80	–	208	–
I	–	–	353	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	–	117	–	20
	LL	–	16	–	4
	WL	–	–	4	13
I	*DL*	–	215	–	–
	LL	38	38	–	–
	WL	–	9	–	15

TABLE 100 DESIGN FORCES

Span : 12.0 m
Frame spacing : 6.0 m
Column height : 6.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :

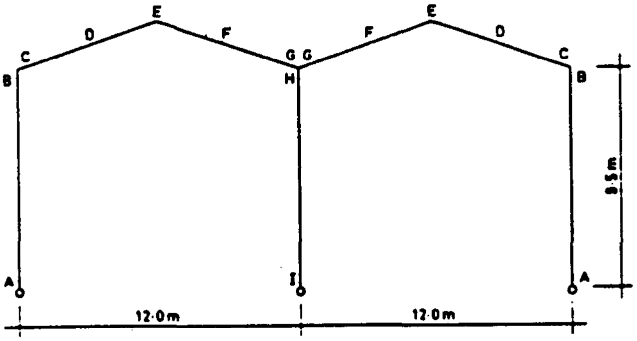


Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	183	–
B	210	–	111	–
C	210	54	–	108
D	1	143	–	53
E	–	165	–	25
F	–	94	–	81
G	332	–	–	138
H	127	–	213	–
I	–	–	372	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
A	*DL*	–	127	–	14
	LL	–	16	–	3
	WL	–	–	1	17
I	*DL*	–	231	–	–
	LL	–	39	–	–
	WL	–	8	–	18

TABLE 101 DESIGN FORCES



Span : 12.0 m
Frame spacing : 6.0 m
Column height : 9.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :

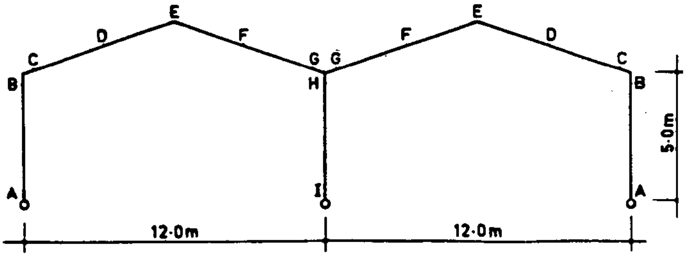
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	229	–
B	287	–	139	–
C	287	138	–	121
D	–	199	–	71
E	–	214	–	47
F	16	132	–	103
G	465	–	–	168
H	255	–	277	–
I	–	–	467	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
A	*DL*	–	174	–	8
	LL	–	15	–	2
	WL	–	9	–	16
I	*DL*	–	308	–	–
	LL	–	40	–	–
	WL	–	5	–	25

TABLE 102 DESIGN FORCES

Span : 12.0 m
Frame spacing : 12.0 m
Column height : 5.0 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :

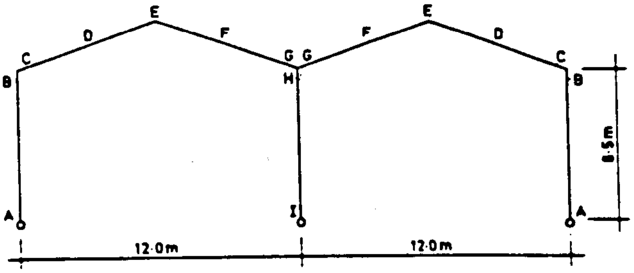


Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	267	–
B	315	–	172	–
C	315	73	–	183
D	13	229	–	87
E	–	265	–	38
F	6	147	–	132
G	541	14	–	228
H	160	–	320	–
I	–	–	580	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
	DL	–	169	–	30
A	*LL*	–	32	–	8
	WL	–	–	8	26
	DL	–	332	–	–
I	*LL*	–	76	–	–
	WL	–	18	–	29

TABLE 103 DESIGN FORCES



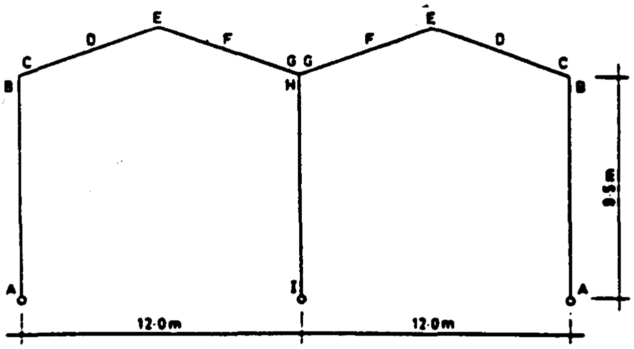
Span : 12.0 m
Frame spacing : 12.0 m
Column height : 6.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :

Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	274	–
B	356	–	177	–
C	356	139	–	181
D	24	255	–	89
E	–	288	–	52
F	10	168	–	141
G	572	– 9	–	236
H	255	–	329	–
I	–	–	603	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
	DL	–	180	–	25
A	*LL*	–	31	–	5
	WL	–	–	1	35
	DL	–	352	–	–
I	*LL*	–	78	–	–
	WL	–	16	–	36

TABLE 104 DESIGN FORCES



Span : 12.0 m
Frame spacing : 12.0 m
Column height : 9.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :

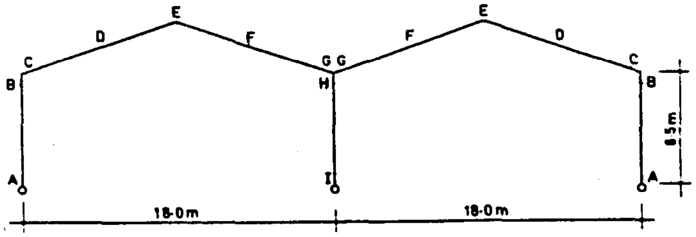
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	320	–
B	511	–	218	–
C	511	311	–	192
D	42	326	–	120
E	–	349	–	83
F	52	234	–	166
G	765	43	–	271
H	512	–	399	–
I	–	–	706	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	–	228	–	12
	LL	–	30	–	3
	WL	–	19	–	51
I	*DL*	–	438	–	–
	LL	–	80	–	–
	WL	–	9	–	40

TABLE 105 DESIGN FORCES

Span	:	18.0 m
Frame spacing	:	6.0 m
Column height	:	6.5 m
Roof slopes	:	1:3, 1:4, 1:5
Support condition	:	Hinged
Wind/seismic zones	:	All
Design Ultimate Forces	:	



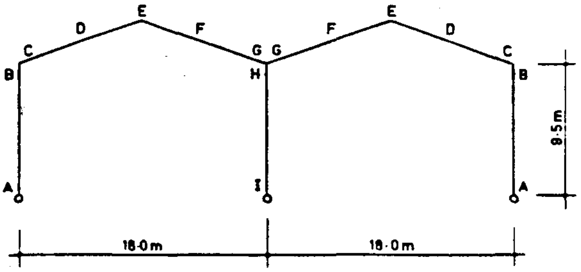
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	274	–
B	443	–	178	–
C	443	1	–	176
D	–	296	–	84
E	–	354	–	28
F	–	191	–	119
G	742	–	–	211
H	141	–	346	–
I	–	–	558	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
			Compressive	*Tensile*	
		(kN.m)	*(kN)*	*(kN)*	*(kN)*
	DL	–	183	–	38
A	*LL*	–	24	–	7
	WL	–	–	8	17
	DL	–	340	–	–
I	*LL*	–	56	–	–
	WL	–	14	–	19

TABLE 106 DESIGN FORCES

Span : 18.0 m
Frame spacing : 6.0 m
Column height : 9.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :

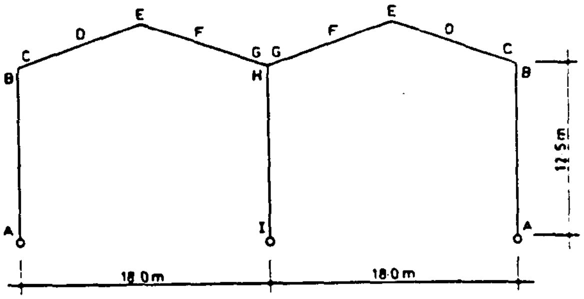


Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	309	–
B	498	–	194	–
C	498	90	–	185
D	–	388	–	88
E	–	437	–	45
F	–	233	–	143
G	879	–	–	242
H	294	–	398	–
I	–	–	643	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	–	225	–	23
	LL	–	23	–	4
	WL	–	–	1	25
I	*DL*	–	409	–	–
	LL	–	58	–	–
	WL	–	12	–	16

TABLE 107 DESIGN FORCES



Span : 18.0 m
Frame spacing : 6.0 m
Column height : 12.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :

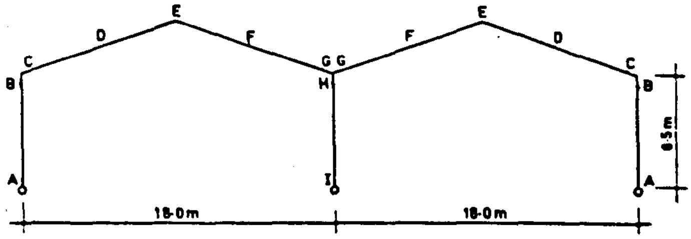
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	369	–
B	600	–	230	–
C	600	208	–	205
D	–	502	–	109
E	–	539	–	69
F	1	295	–	174
G	1117	–	–	285
H	452	–	491	–
I	–	–	772	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
A	*DL*	–	278	–	16
	LL	–	22	–	2
	WL	–	8	–	34
I	*DL*	–	514	–	–
	LL	–	60	–	–
	WL	–	9	–	34

TABLE 108 DESIGN FORCES

Span : 18.0 m
Frame spacing : 12.0 m
Column height : 6.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :



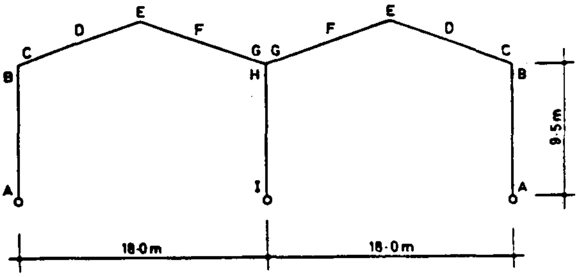
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	396	–
B	681	–	256	–
C	681	112	–	275
D	22	479	–	131
E	–	565	–	57
F	13	310	–	190
G	1179	36	–	334
H	282	–	472	–
I	–	–	851	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	–	247	–	55
	LL	–	48	–	14
	WL	–	–	16	33
I	*DL*	–	483	–	–
	LL	–	113	–	–
	WL	–	28	–	39

TABLE 109 DESIGN FORCES

Span : 18.0 m
Frame spacing : 12.0 m
Column height : 9.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :

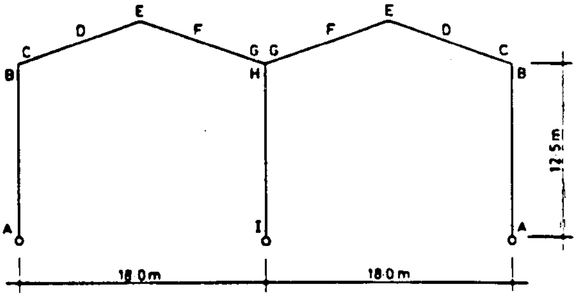


Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	445	–
B	812	–	293	–
C	812	276	–	293
D	9	647	–	141
E	–	651	–	77
F	7	395	–	234
G	1399	–	–	390
H	548	–	573	–
I	–	–	992	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
	DL	–	298	–	33
A	*LL*	–	46	–	7
	WL	–	–	2	51
	DL	–	592	–	–
I	*LL*	–	118	–	–
	WL	–	23	–	53

TABLE 110 DESIGN FORCES



Span : 18.0 m
Frame spacing : 12.0 m
Column height : 12.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :

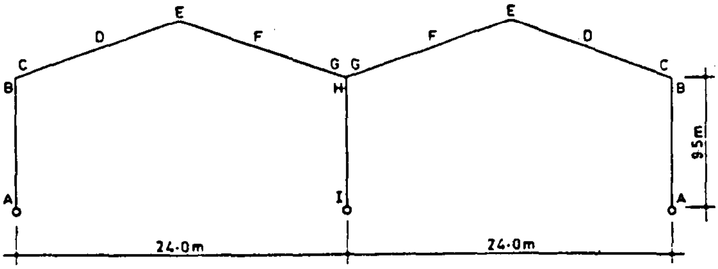
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	522	–
B	1026	–	353	–
C	1 026	511	–	322
D	–	829	–	178
E	–	877	–	118
F	56	512	–	281
G	1810	–	–	457
H	909	–	715	–
I	–	–	1177	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	–	375	–	22
	LL	–	44	–	4
	WL	–	17	–	68
I	*DL*	–	741	–	–
	LL	–	121	–	–
	WL	–	15	–	67

TABLE 111 DESIGN FORCES

Span : 24.0 m
Frame spacing : 6.0 m
Column height : 9.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :



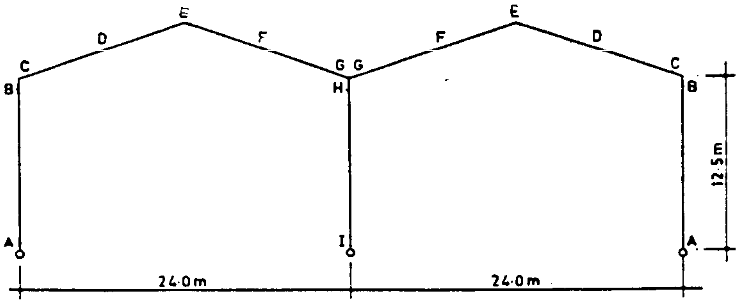
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	494	–
B	1021	–	326	–
C	1021	–	–	304
D	–	720	–	145
E	–	848	–	54
F	–	439	–	213
G	1757	–	–	371
H	294	–	669	–
I	–	–	993	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	–	347	–	61
	LL	–	32	–	8
	WL	–	–	9	25
I	*DL*	–	638	–	–
	LL	–	76	–	–
	WL	–	18	–	28

TABLE 112 DESIGN FORCES

Span : 24.0 m
Frame spacing : 6.0 m
Column height : 12.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :



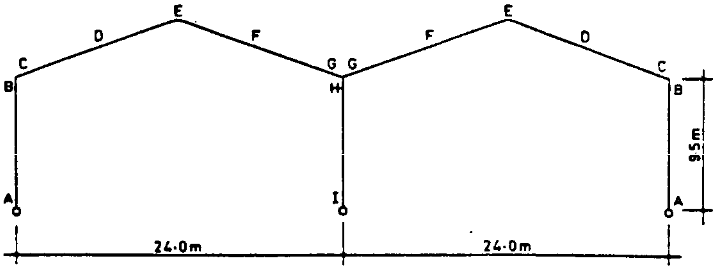
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	550	–
B	1085	–	349	–
C	1085	40	–	319
D	–	886	–	150
E	–	999	–	77
F	–	506	–	246
G	2014	–	–	415
H	475	–	781	–
I	–	–	1119	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
A	*DL*	–	403	–	43
	LL	–	31	–	5
	WL	–	–	2	33
I	*DL*	–	742	–	–
	LL	–	78	–	–
	WL	–	16	–	35

TABLE - 113 DESIGN FORCES

Span	: 24.0 m
Frame spacing	: 12.0 m
Column height	: 9.5 m
Roof slopes	: 1:3, 1:4, 1:5
Support condition	: Hinged
Wind/seismic zones	: All
Design Ultimate Forces	:



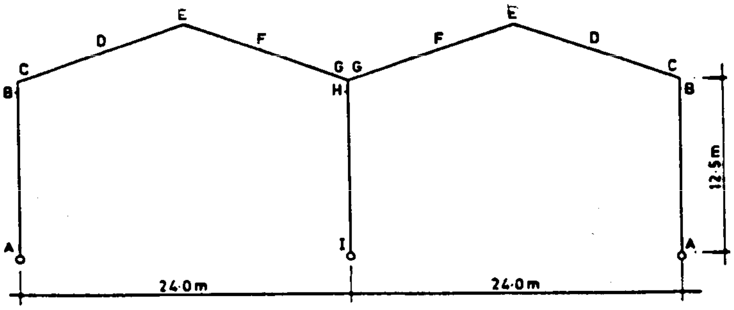
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	662	–
B	1470	–	435	–
C	1470	130	–	438
D	–	1069	–	209
E	–	1246	–	82
F	–	664	–	312
G	2574	–	–	541
H	587	–	852	–
I	–	–	1399	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
	DL	–	435	–	81
A	*LL*	–	64	–	16
	WL	–	–	18	49
	DL	–	839	–	–
I	*LL*	–	152	–	–
	WL	–	36	–	56

TABLE 114 DESIGN FORCES

Span : 24.0 m
Frame spacing : 12.0 m
Column height : 12.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :



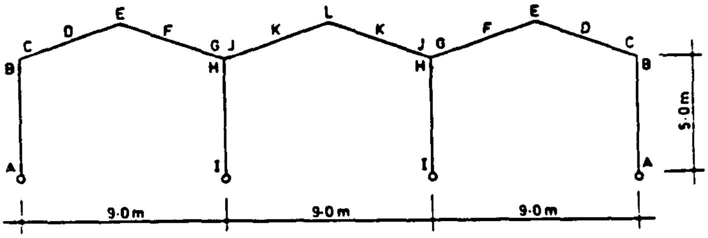
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	771	–
B	1676	–	510	–
C	1676	339	–	487
D	–	1441	–	231
E	–	1587	–	129
F	–	825	–	389
G	3177	–	–	650
H	954	–	1068	–
I	–	–	1678	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	–	540	–	58
	LL	–	61	–	10
	WL	–	–	3	67
I	*DL*	–	1054	–	–
	LL	–	157	–	–
	WL	–	30	–	70

TABLE 115 DESIGN FORCES

Span	: 9.0 m
Frame spacing	: 6.0 m
Column height	: 5.0 m
Roof slopes	: 1:3, 1:4, 1:5
Support condition	: Hinged
Wind/seismic zones	: All
Design Ultimate Forces	:



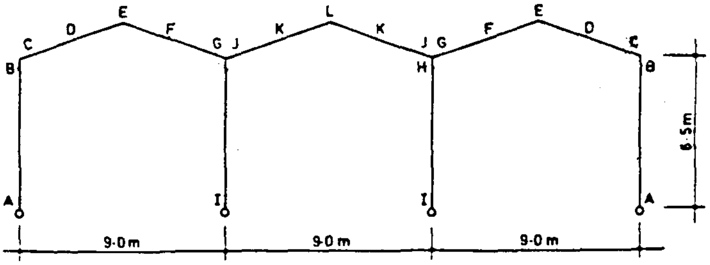
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	116	–
B	100	–	69	–
C	100	32	–	73
D	2	76	–	35
E	–	89	–	18
F	3	50	–	53
G	154	–	–	90
H	9	–	200	–
I	–	–	229	–
J	161	–	–	90
K	–	46	–	48
L	–	61	–	16

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	–	78	–	9
	LL	–	12	–	8
	WL	–	–	2	11
I	*DL*	–	138	–	1
	LL	–	27	–	–
	WL	–	11	–	12

TABLE 116 DESIGN FORCES

Span	:	9.0 m
Frame spacing	:	6.0 m
Column height	:	6.5 m
Roof slopes	:	1:3, 1:4, 1:5
Support condition	:	Hinged
Wind/seismic zones	:	All
Design Ultimate Forces	:	



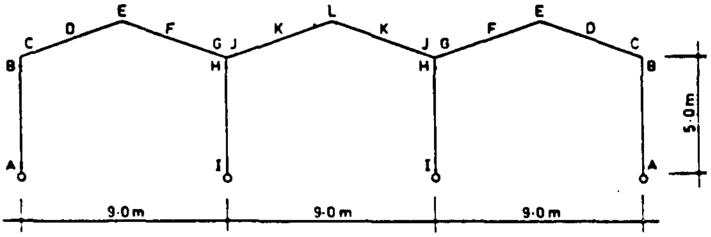
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	112	–
B	116	–	73	–
C	116	56	–	72
D	5	84	–	39
E	–	96	–	23
F	10	58	–	55
G	175	–	–	93
H	101	–	115	–
I	–	–	238	–
J	182	–	–	93
K	4	54	–	52
L	–	62	–	22

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
	DL	–	86	–	6
A	*LL*	–	12	–	1
	WL	–	1	–	14
	DL	–	148	–	1
I	*LL*	–	28	–	–
	WL	–	11	–	14

TABLE 117 DESIGN FORCES

Span : 9.0 m
Frame spacing : 12.0 m
Column height : 5.0 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :



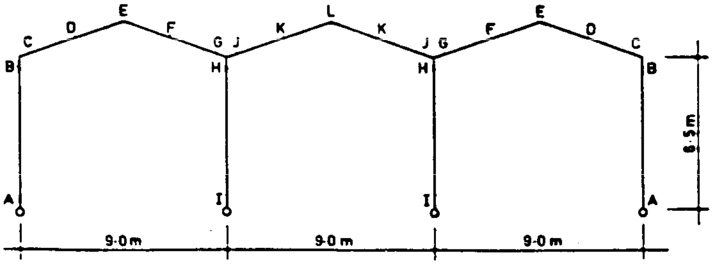
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	182	–
B	174	–	115	–
C	174	75	–	126
D	13	140	–	61
E	4	161	–	37
F	12	89	–	94
G	272	21	–	159
H	134	–	199	–
I	–	–	383	–
J	288	21	–	159
K	7	86	–	85
L	–	109	–	32

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
A	*DL*	–	115	–	13
	LL	–	24	–	4
	WL	–	–	4	22
I	*DL*	–	216	–	1
	LL	–	55	–	1
	WL	–	23	–	24

TABLE 118 DESIGN FORCES

Span : 9.0 m
Frame spacing : 12.0 m
Column height : 6.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :



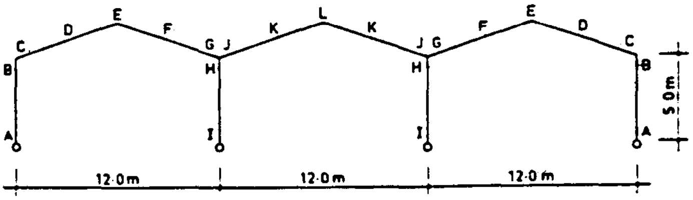
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	189	–
B	210	–	122	–
C	210	123	–	125
D	19	154	–	69
E	–	173	–	46
F	26	106	–	98
G	310	17	–	163
H	204	–	200	–
I	–	–	395	–
J	328	18	–	163
K	12	102	–	93
L	3	110	–	43

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
	DL	–	124	–	9
A	*LL*	–	23	–	2
	WL	–	3	–	29
	DL	–	131	–	1
I	*LL*	–	55	–	–
	WL	–	22	–	29

TABLE 119 DESIGN FORCES

Span	: 12.0 m
Frame spacing	: 6.0 m
Column height	: 5.0 m
Roof slopes	: 1:3, 1:4, 1:5
Support condition	: Hinged
Wind/seismic zones	: All
Design Ultimate Forces	:



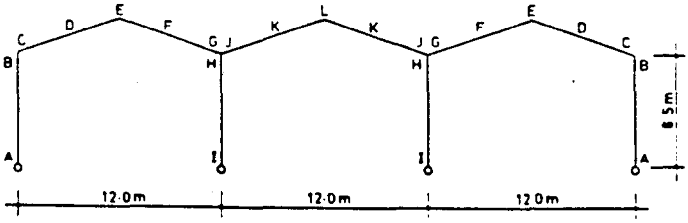
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	178	–
B	197	–	110	–
C	197	12	–	112
D	–	124	–	55
E	–	155	–	20
F	–	87	–	73
G	288	–	–	129
H	12	–	298	–
I	–	–	338	–
J	287	–	–	129
K	–	81	–	66
L	–	199	–	15

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	–	119	–	22
	LL	–	16	–	4
	WL	–	–	5	11
I	*DL*	–	207	–	–
	LL	–	36	–	–
	WL	–	16	–	14

TABLE 120 DESIGN FORCES

Span : 12.0 m
Frame spacing : 6.0 m
Column height : 6.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :

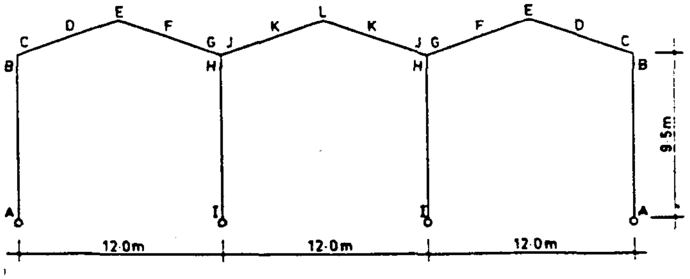


Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	186	–
B	206	–	110	–
C	206	40	–	111
D	–	142	–	54
E	–	171	–	24
F	–	96	–	78
G	304	–	–	135
H	115	–	175	–
I	–	–	353	–
J	316	–	–	135
K	–	89	–	71
L	–	123	–	21

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	–	129	–	15
	LL	–	16	–	3
	WL	–	–	3	14
I	*DL*	–	222	–	1
	LL	–	36	–	–
	WL	–	15	–	16

TABLE 121 DESIGN FORCES



Span : 12.0 m
Frame spacing : 6.0 m
Column height : 9.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :

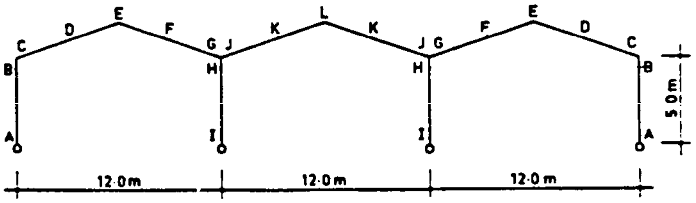
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	234	–
B	259	–	136	–
C	259	102	–	125
D	–	202	–	69
E	–	228	–	38
F	7	135	–	99
G	415	–	–	163
H	206	–	205	–
I	–	–	438	–
J	423	–	–	163
K	–	118	–	991
L	–	143	–	35

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
	DL	–	176	–	9
A	*LL*	–	15	–	2
	WL	–	4	–	21
	DL	–	293	–	1
I	*LL*	–	37	–	–
	WL	–	14	–	21

TABLE 122 DESIGN FORCES

Span : 12.0 m
Frame spacing : 12.0 m
Column height : 5.0 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :



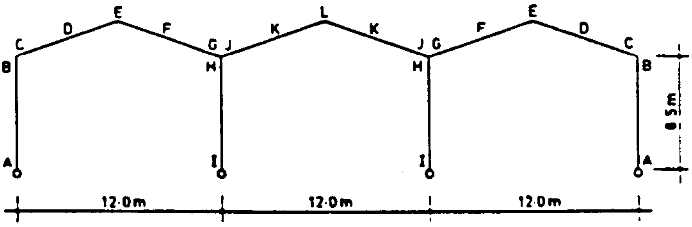
Section Designation	Bending Moment		Compressive Force	Shear Force
	Hogging (kN.m)	Sagging (kN.m)	(kN)	(kN)
A	–	–	273	–
B	319	–	173	–
C	319	60	–	187
D	10	225	–	92
E	–	273	–	41
F	6	149	–	126
G	496	15	–	222
H	165	–	160	–
I	–	–	551	–
J	494	15	–	222
K	6	142	–	114
L	–	204	–	30

Foundation Forces at Service Load Stage :

Section Designation	Forces Due to	Bending Moment	Axial Force		Shear Force
		(kN.m)	Compressive (kN)	Tensile (kN)	(kN)
	DL	–	173	–	33
A	*LL*	–	32	–	8
	WL	–	–	10	22
	DL	–	318	–	1
I	*LL*	–	72	–	1
	WL	–	31	–	28

TABLE 123 DESIGN FORCES

Span : 12.0 m
Frame spacing : 12.0 m
Column height : 6.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :

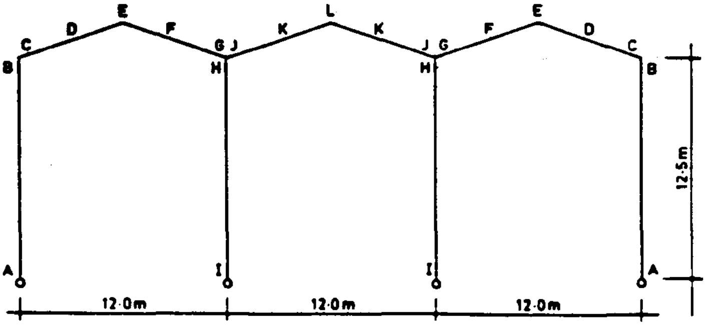


Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	281	–
B	342	–	175	–
C	342	113	–	186
D	12	255	–	90
E	–	300	–	49
F	11	168	–	134
G	520	11	–	230
H	130	–	293	–
I	–	–	569	–
J	547	12	–	230
K	6	159	–	122
L	–	210	–	42

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
	DL	–	183	–	22
A	*LL*	–	32	–	6
	WL	–	–	6	29
	DL	–	336	–	2
I	*LL*	–	73	–	1
	WL	–	30	–	32

TABLE 124 DESIGN FORCES



Span	: 12.0 m
Frame spacing	: 12.0 m
Column height	: 12.5 m
Roof slopes	: 1:3, 1:4, 1:5
Support condition	: Hinged
Wind/seismic zones	: All
Design Ultimate Forces	:

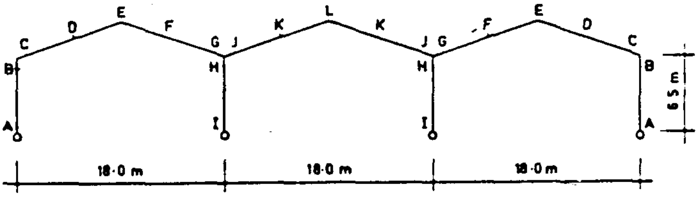
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	319	–
B	445	–	209	–
C	445	240	–	199
D	8	335	–	114
E	–	374	–	66
F	41	230	–	158
G	680	–	–	263
H	420	–	323	–
I	–	–	651	–
J	709	–	–	263
K	25	212	–	150
L	–	232	–	61

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	–	232	–	13
	LL	–	31	–	3
	WL	–	8	–	42
I	*DL*	–	413	–	2
	LL	–	74	–	1
	WL	–	29	–	41

TABLE 125 DESIGN FORCES

Span	: 18.0 m
Frame spacing	: 6.0 m
Column height	: 6.5 m
Roof slopes	: 1:3, 1:4, 1:5
Support condition	: Hinged
Wind/seismic zones	: All
Design Ultimate Forces	:



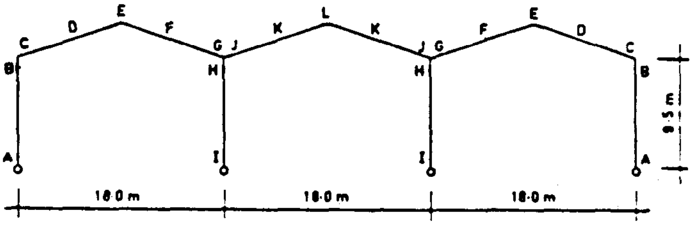
Section Designation	Bending Moment		Compressive Force	Shear Force
	Hogging (kN.m)	Sagging (kN.m)	(kN)	(kN)
A	–	–	280	–
B	469	–	225	–
C	469	–	–	180
D	–	286	–	89
E	–	359	–	27
F	–	201	–	113
G	680	–	–	205
H	164	–	443	–
I	–	–	535	–
J	671	–	–	205
K	–	184	–	104
L	–	279	–	20

Foundation Forces at Service Load Stage :

Section Designation	Forces Due to	Bending Moment (kN.m)	Axial Force		Shear Force (kN)
			Compressive (kN)	Tensile (kN)	
A	DL	–	187	–	42
	LL	–	25	–	8
	WL	–	–	9	14
I	DL	–	329	–	–
	LL	–	54	–	–
	WL	–	23	–	20

TABLE 126 DESIGN FORCES

Span : 18.0 m
Frame spacing : 6.0 m
Column height : 9.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :



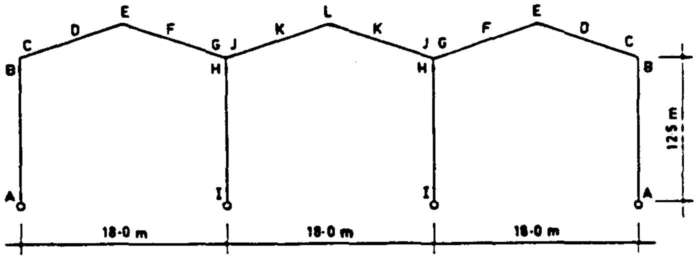
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	316	–
B	495	–	195	–
C	495	58	–	191
D	–	387	–	92
E	–	457	–	39
F	–	245	–	137
G	798	–	–	235
H	244	–	306	–
I	–	–	608	–
J	809	–	–	255
K	–	218	–	122
L	–	317	–	33

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	–	224	–	26
	LL	–	24	–	4
	WL	–	–	5	21
I	*DL*	–	390	–	2
	LL	–	55	–	1
	WL	–	23	–	25

TABLE 127 DESIGN FORCES

Span	: 18.0 m
Frame spacing	: 6.0 m
Column height	: 12.5 m
Roof slopes	: 1:3, 1:4, 1:5
Support condition	: Hinged
Wind/seismic zones	: All
Design Ultimate Forces	:



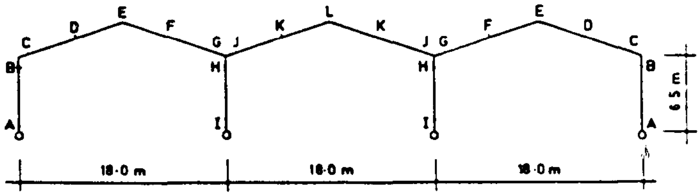
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	377	–
B	564	–	228	–
C	564	144	–	212
D	–	512	–	108
E	–	577	–	56
F	–	316	–	166
G	999	–	–	277
H	380	–	469	–
I	–	–	722	–
J	1010	–	–	277
K	–	264	–	147
L	–	360	–	49

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	–	283	–	18
	LL	–	23	–	3
	WL	–	2	–	27
I	*DL*	–	487	–	2
	LL	–	55	–	1
	WL	–	22	–	28

TABLE 128 DESIGN FORCES

Span : 18.0 m
Frame spacing : 12.0 m
Column height : 6.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :



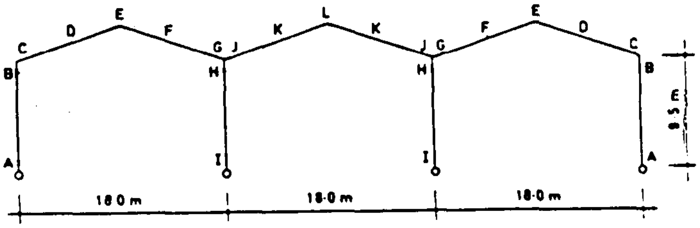
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	406	–
B	708	–	348	–
C	708	90	–	282
D	24	465	–	138
E	–	575	–	56
F	14	319	–	180
G	1079	36	–	324
H	320	–	434	–
I	–	–	813	–
J	1063	35	–	324
K	13	303	–	164
L	–	444	–	36

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	–	252	–	60
	LL	–	49	–	15
	WL	–	–	18	29
I	*DL*	–	466	–	3
	LL	–	108	–	1
	WL	–	47	–	40

TABLE 129 DESIGN FORCES

Span : 18.0 m
Frame spacing : 12.0 m
Column height : 9.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :



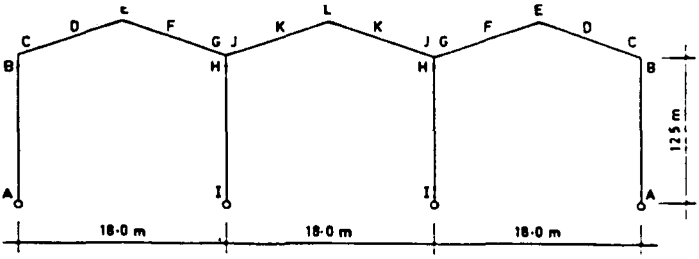
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	456	–
B	786	–	291	–
C	786	217	–	303
D	–	649	–	146
E	–	752	–	70
F	4	404	–	222
G	1288	–	–	379
H	492	–	484	–
I	–	–	932	–
J	1329	–	–	379
K	–	372	–	198
L	–	511	–	64

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	–	304	–	36
	LL	–	47	–	8
	WL	–	–	9	42
I	*DL*	–	562	–	3
	LL	–	110	–	1
	WL	–	46	–	47

TABLE 130 DESIGN FORCES

Span : 18.0 m
Frame spacing : 12.0 m
Column height : 12.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :



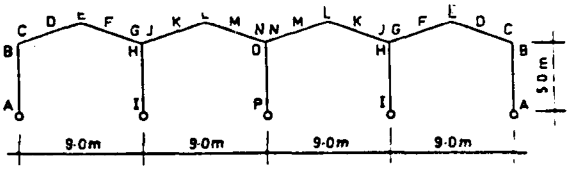
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	536	–
B	929	–	346	–
C	929	386	–	334
D	–	851	–	174
E	–	945	–	95
F	29	528	–	267
G	1617	–	–	443
H	754	–	553	–
I	–	–	1094	–
J	1667	–	–	443
K	3	461	–	240
L	–	577	–	92

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	–	383	–	25
	LL	–	46	–	5
	WL	–	4	–	56
I	*DL*	–	696	–	4
	LL	–	111	–	1
	WL	–	44	–	56

TABLE 131 DESIGN FORCES

Span : 9.0 m
Frame spacing : 6.0 m
Column height : 5.0 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :



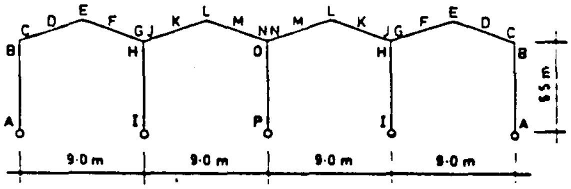
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	116	–
B	99	–	69	–
C	99	26	–	73
D	–	74	–	35
E	–	87	–	18
F	–	49	–	52
G	153	–	–	90
H	63	–	180	–
I	–	–	231	–
J	161	–	–	90
K	1	44	–	48
L	–	63	–	16
M	1	47	–	46
N	150	1	–	81
O	–	–	186	–
P	–	–	215	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	–	79	–	9
	LL	–	12	–	2
	WL	–	–	2	10
I	*DL*	–	139	–	–
	LL	–	28	–	–
	WL	–	11	–	11
P	*DL*	–	132	–	–
	LL	–	26	–	–
	WL	–	18	–	10

TABLE 132 DESIGN FORCES

Span : 9.0 m
Frame spacing : 6.0 m
Column height : 6.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :



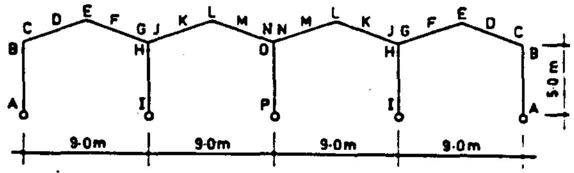
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	122	–
B	109	–	71	–
C	109	47	–	72
D	1	83	–	38
E	–	94	–	22
F	7	56	-	55
G	163	–	–	93
H	90	–	115	–
I	–	–	241	–
J	180	–	–	93
K	2	51	–	51
L	–	65	–	22
M	2	54	–	50
N	168	–	–	84
O	84	–	179	–
P	–	–	222	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
	DL	–	86	–	6
A	*LL*	–	12	–	1
	WL	–	–	–	13
	DL	–	150	–	–
I	*LL*	–	26	–	–
	WL	–	10	–	12
	DL	–	141	–	–
P	*LL*	–	26	–	–
	WL	–	18	–	12

TABLE 133 DESIGN FORCES

Span : 9.0 m
Frame spacing : 12.0 m
Column height : 5.0 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :



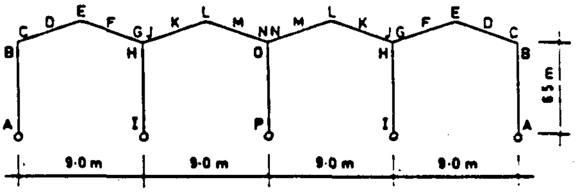
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	182	–
B	169	–	114	–
C	169	64	–	126
D	9	137	–	61
E	4	159	–	36
F	8	88	–	94
G	270	21	–	159
H	7	–	355	–
I	–	–	387	–
J	287	21	–	159
K	7	83	–	84
L	3	111	–	32
M	7	85	–	82
N	270	21	–	142
O	104	–	207	–
P	–	–	357	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	–	116	–	14
	LL	–	24	–	4
	WL	–	–	5	20
I	*DL*	–	220	–	–
	LL	–	56	–	–
	WL	–	21	–	21
P	*DL*	–	207	–	–
	LL	–	51	–	–
	WL	–	36	–	19

TABLE 134 DESIGN FORCES

Span	: 9.0 m
Frame spacing	: 12. 0 m
Column height	: 6.5 m
Roof slopes	: 1:3, 1:4, 1:5
Support condition	: Hinged
Wind/seismic zones	: All
Design Ultimate Forces	:



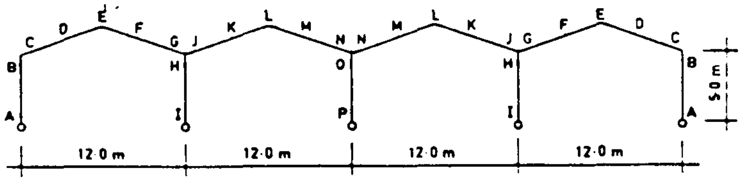
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	189	–
B	194	–	119	–
C	194	103	–	125
D	10	152	–	67
E	–	170	–	44
F	21	102	–	98
G	288	117	–	164
H	180	–	199	–
I	–	–	400	–
J	322	18	–	164
K	8	97	–	91
L	2	113	–	43
M	01	99	–	89
N	305	20	–	149
O	170	–	311	–
P	–	–	366	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment*	*Axial Force*		*Shear Force*
		(kN.m)	*Compressive (kN)*	*Tensile (kN)*	*(kN)*
A	*DL*	–	124	–	9
	LL	–	23	–	3
	WL	–	1	–	26
I	*DL*	–	233	–	–
	LL	–	56	–	–
	WL	–	20	–	25
P	*DL*	–	216	–	–
	LL	–	51	–	–
	WL	–	37	–	23

TABLE 135 DESIGN FORCES

Span : 12.0 m
Frame spacing : 6.0 m
Column height : 5.0 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :



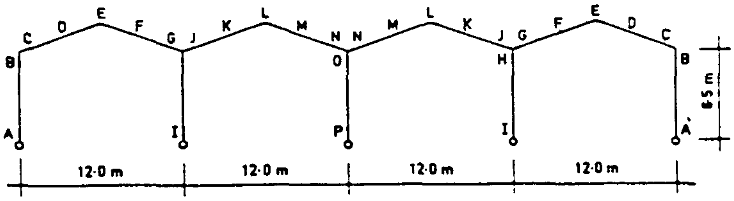
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	180	–
B	204	–	111	–
C	204	5	–	113
D	–	120	–	56
E	–	153	–	20
F	–	89	–	71
G	283	–	–	128
H	95	–	273	–
I	–	–	340	–
J	290	–	–	128
K	–	77	–	66
L	–	119	–	15
M	–	82	–	64
N	273	–	–	118
O	–	–	284	–
P	—	–	324	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
	DL	–	120	–	23
A	*LL*	–	17	–	5
	WL	–	–	6	10
	DL	–	208	–	2
I	*LL*	–	36	–	–
	WL	–	115	–	3
	DL	–	201	–	–
P	*LL*	–	34	–	–
	WL	–	23	–	10

TABLE 136 DESIGN FORCES

Span : 12.0 m
Frame spacing : 6.0 m
Column height : 6.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :



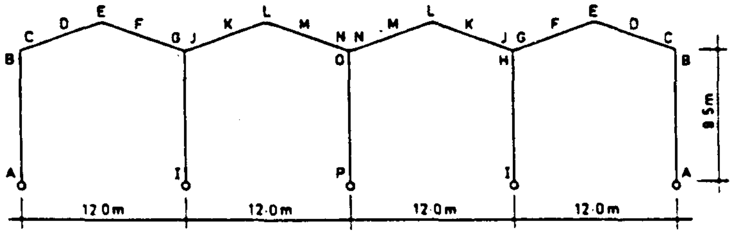
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	187	–
B	206	–	110	–
C	206	30	–	112
D	–	139	–	55
E	–	169	–	24
F	–	96	–	77
G	302	–	–	134
H	114	–	277	–
I	–	–	356	–
J	317	–	–	134
K	–	85	–	71
L	–	126	–	22
M	–	92	–	68
N	294	–	–	121
O	92	–	274	–
P	–	–	335	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
	DL	–	130	–	16
A	*LL*	–	16	–	3
	WL	–	–	4	13
	DL	–	223	–	1
I	*LL*	–	37	–	–
	WL	–	14	–	14
	DL	–	213	–	–
P	*LL*	–	34	–	–
	WL	–	23	–	12

TABLE 137 DESIGN FORCES

Span	: 12.0 m
Frame spacing	: 6.0 m
Column height	: 9.5 m
Roof slopes	: 1:3, 1:4, 1:5
Support condition	: Hinged
Wind/seismic zones	: All
Design Ultimate Forces	:



Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	234	–
B	242	–	133	–
C	242	81	–	125
D	–	199	–	67
E	–	225	–	33
F	3	130	–	98
G	392	–	–	164
H	183	–	206	–
I	–	–	443	–
J	421	–	–	164
K	–	112	–	91
L	–	152	–	37
M	–	123	–	86
N	384	–	–	147
O	175	–	319	–
P	–	–	409	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	–	176	–	9
	LL	–	15	–	2
	WL	–	2	–	19
I	*DL*	–	296	–	1
	LL	–	38	–	–
	WL	–	13	–	17
P	*DL*	–	277	–	–
	LL	–	34	–	–
	WL	–	24	–	17

TABLE 138 DESIGN FORCES

Span : 12.0 m

Frame spacing : 12.0 m

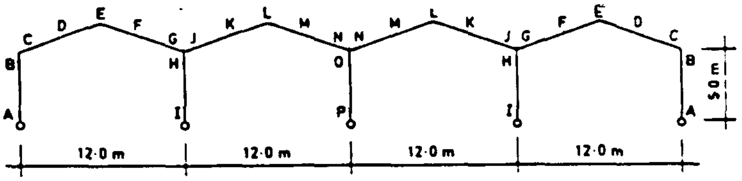
Column height : 5.0 m

Roof slopes : 1:3, 1:4, 1:5

Support condition : Hinged

Wind/seismic zones : All

Design Ultimate Forces :



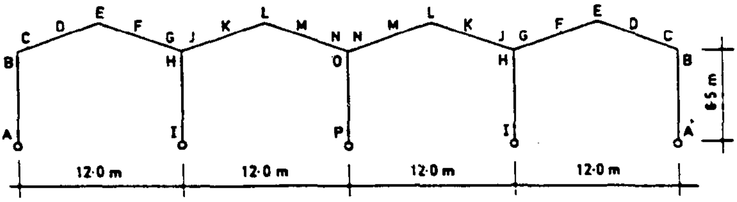
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	276	–
B	327	–	174	–
C	327	48	–	189
D	11	218	–	93
E	–	269	–	41
F	6	152	–	124
G	489	15	–	220
H	22	–	496	–
I	–	–	555	–
J	497	15	–	220
K	6	136	–	113
L	–	203	–	30
M	6	143	–	110
N	471	15	–	199
O	–	–	479	–
P	–	–	524	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	–	174	–	34
	LL	–	33	–	9
	WL	–	–	11	21
I	*DL*	–	320	–	2
	LL	–	73	–	–
	WL	–	29	–	26
P	*DL*	–	306	–	–
	LL	–	68	-	–
	WL	–	46	–	21

TABLE 139 DESIGN FORCES

Span : 12.0 m
Frame spacing : 12.0 m
Column height : 6.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :



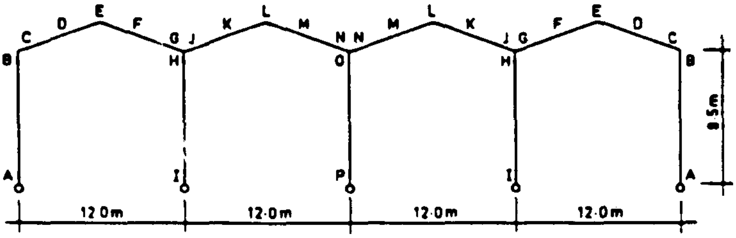
Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	282	–
B	338	–	175	–
C	338	94	–	187
D	6	250	–	91
E	–	296	–	48
F	5	166	–	133
G	520	11	–	229
H	194	–	287	–
I	–	–	574	–
J	547	11	–	229
K	6	152	–	121
L	–	216	–	42
M	5	160	–	117
N	510	14	–	206
O	185	–	458	–
P	–	–	535	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	–	184	–	23
	LL	–	32	–	6
	WL	–	–	7	26
I	*DL*	–	338	–	1
	LL	–	74	–	–
	WL	–	29	–	28
P	*DL*	–	300	–	–
	LL	–	68	–	–
	WL	–	47	–	25

TABLE 140 DESIGN FORCES

Span : 12.0 m
Frame spacing : 12.0 m
Column height : 9.5 m
Roof slopes : 1:3, 1:4, 1:5
Support condition : Hinged
Wind/seismic zones : All
Design Ultimate Forces :



Section Designation	*Bending Moment*		*Compressive Force*	*Shear Force*
	Hogging (kN.m)	*Sagging (kN.m)*	*(kN)*	*(kN)*
A	–	–	327	–
B	409	–	203	–
C	409	197	–	199
D	–	330	–	109
E	–	368	–	62
F	31	221	–	146
G	636	–	–	263
H	369	–	324	–
I	–	–	667	–
J	699	–	–	263
K	14	200	–	148
L	–	242	–	68
M	13	210	–	142
N	649	–	–	240
O	354	–	503	–
P	–	–	610	–

Foundation Forces at Service Load Stage :

Section Designation	*Forces Due to*	*Bending Moment (kN.m)*	*Axial Force*		*Shear Force (kN)*
			Compressive (kN)	*Tensile (kN)*	
A	*DL*	–	232	–	13
	LL	–	31	–	3
	WL	–	4	–	37
I	*DL*	–	417	–	1
	LL	–	75	–	–
	WL	–	26	–	35
P	*DL*	–	387	–	–
	LL	–	68	–	–
	WL	–	49	–	33

TABLE 141 LOCATION OF JOINTS AND LIFTING POINTS DURING TRANSPORTATION AND ERECTION (REFER FIG. 150)

(a) *For Gable Frames with Fixed Bases*

Span (m)	*Spacing* (m)	*Column Height* (m)	*Slope* 1 IN	*a* (mm)	*b* (mm)
9	6	5.0	3	1436	1760
9	6	5.0	4	1403	1720
9	6	5.0	5	1388	1700
9	6	6.5	3	1452	1950
9	6	6.5	4	1419	1950
9	6	6.5	5	1403	1980
9	12	5.0	3	1468	2140
9	12	5.0	4	1434	2180
9	12	5.0	5	1419	2250
9	12	6.5	3	1468	2140
9	12	6.5	4	1434	2180
9	12	6.5	5	1419	2250
12	6	5.0	3	1942	2690
12	6	5.0	4	1898	2720
12	6	5.0	5	1877	2790
12	6	6.5	3	1942	2690
12	6	6.5	4	1898	2720
12	6	6.5	5	1877	2790
12	6	9.5	3	1942	2690
12	6	9.5	4	1898	2720
12	6	9.5	5	1877	2790
12	12	5.0	3	1942	2690
12	12	5.0	4	1898	2720
12	12	5.0	5	1877	2790
12	12	6.5	3	1942	2690
12	12	6.5	4	1898	2720
12	12	6.5	5	1877	2790
12	12	9.5	3	1942	2690
12	12	9.5	4	1898	2720
12	12	9.5	5	1877	2790
18	6	6.5	3	2923	4170
18	6	6.5	4	2857	4270
18	6	6.5	5	2826	4420
18	6	9.5	3	2923	4170
18	6	9.5	4	2857	4270
18	6	9.5	5	2826	4420

Note – Distances *a* and *b* are same in single bay and multi-bay frames.

(Continued)

TABLE 141 LOCATION OF JOINTS AND LIFTING POINTS DURING TRANSPORTATION AND ERECTION (REFER FIG. 150) – *Contd*

Span (*m*)	*Spacing* (*m*)	*Column Height* (*m*)	*Slope* *1 IN*	*a* (*mm*)	*b* (*mm*)
18	6	12.5	3	2923	4170
18	6	12.5	4	2857	4270
18	6	12.5	5	2826	4420
18	12	6.5	3	2923	4170
18	12	6.5	4	2857	4270
18	12	6.5	5	2826	4420
18	12	9.5	3	2923	4170
18	12	9.5	4	2857	4270
18	12	9.5	5	2826	4420
18	12	12.5	3	2923	4170
18	12	12.5	4	2857	4270
18	12	12.5	5	2826	4420
24	6	9.5	3	3903	5650
24	6	9.5	4	3815	5810
24	6	9.5	5	3774	6040
24	6	12.5	3	3903	5650
24	6	12.5	4	3815	5810
24	6	12.5	5	3774	6040
24	12	9.5	3	3903	5650
24	12	9.5	4	3815	5810
24	12	9.5	5	3774	6040
24	12	12.5	3	3903	5650
24	12	12.5	4	3815	5810
24	12	12.5	5	3774	6040
30	6	9.5	3	4852	6750
30	6	9.5	4	4743	6890
30	6	9.5	5	4692	7110
30	6	12.5	3	4852	6750
30	6	12.5	4	4743	6890
30	6	12.5	5	4692	7110
30	12	9.5	3	4852	6750
30	12	9.5	4	4743	6890
30	12	9.5	5	4692	7110
30	12	12.5	3	4852	6750
30	12	12.5	4	4743	6890
30	12	12.5	5	4692	7110

Note – Distances *a* and *b* are same in single bay and multi-bay frames.

(Continued)

TABLE 141 LOCATION OF JOINTS AND LIFTING POINTS DURING TRANSPORTATION AND ERECTION (REFER FIG. 150) – *Contd*

(b) *For Gable Frames with Hinged Bases*

Span (*m*)	*Spacing* (*m*)	*Column Height* (*m*)	*Slope* *1 IN*	*a* (*mm*)	*b* (*mm*)
9	6	5.0	3	1436	2430
9	6	5.0	4	1403	2570
9	6	5.0	5	1388	2740
9	6	6.5	3	1436	2430
9	6	6.5	4	1403	2570
9	6	6.5	5	1388	2740
9	12	5.0	3	1436	2430
9	12	5.0	4	1403	2570
9	12	5.0	5	1388	2740
9	12	6.5	3	1436	2430
9	12	6.5	4	1403	2570
9	12	6.5	5	1388	2740
12	6	5.0	3	1926	3010
12	6	5.0	4	1883	3130
12	6	5.0	5	1862	3290
13	6	6.5	3	1926	3010
12	6	6.5	4	1883	3130
12	6	6.5	5	1862	3290
12	6	9.5	3	1926	3340
12	6	9.5	4	1883	3560
12	6	9.5	5	1862	3810
12	12	5.0	3	1926	3340
12	12	5.0	4	1883	3560
12	12	5.0	5	1862	3810
12	12	6.5	3	1926	3340
12	12	6.5	4	1883	3560
12	12	6.5	5	1862	3810
12	12	9.5	3	1926	3340
12	12	9.5	4	1883	3560
12	12	9.5	5	1862	3810
18	6	6.5	3	2875	4280
18	6	6.5	4	2810	4430
18	6	6.5	5	2780	4620
18	6	9.5	3	2875	4450
18	6	9.5	4	2810	4640
18	6	9.5	5	2780	4880

Note – Distances *a* and *b* are same in single bay and multi-bay frames.

(Continued)

TABLE 141 LOCATION OF JOINTS AND LIFTING POINTS DURING TRANSPORTATION AND ERECTION (REFER FIG. 150) – *Contd.*

Span (*m*)	*Spacing* (*m*)	*Column Height* (*m*)	*Slope* *1 IN*	*a* (*mm*)	*b* (*mm*)
18	6	12.5	3	2875	4780
18	6	12.5	4	2810	5060
18	6	12.5	5	2780	5400
18	12	6.5	3	2875	4450
18	12	6.5	4	2810	4640
18	12	6.5	5	2780	4880
18	12	9.5	3	2875	4780
18	12	9.5	4	2810	5060
18	12	9.5	5	2780	5040
18	12	12.5	3	2875	5280
18	12	12.5	4	2810	5700
18	12	12.5	5	2780	6180
24	6	9.5	3	3040	5740
24	6	9.5	4	3754	5950
24	6	9.5	5	3713	6230
24	6	12.5	3	3840	5910
24	6	12.5	4	3754	6160
24	6	12.5	5	3713	6490
24	12	9.5	3	3840	5910
24	12	9.5	4	3754	6160
24	12	9.5	5	3713	6490
24	12	12.5	3	3840	6410
24	12	12.5	4	3754	6800
24	12	12.5	5	3713	7270
30	6	9.5	3	4812	6870
30	6	9.5	4	4704	7060
30	6	9.5	5	4654	7330
30	6	12.5	3	4812	7210
30	6	12.5	4	4704	7480
30	6	12.5	5	4654	7850
30	12	9.5	3	4812	7210
30	12	9.5	4	4754	7480
30	12	9.5	5	4704	7850
30	12	12.5	3	4812	7210
30	12	12.5	4	4754	7480
30	12	12.5	5	4704	7850

Note – Distances *a* and *b* are same in single bay and multi-bay frames.

TABLE 142 DETAILS OF TYPE (1) JOINT IN THE RAFTER (REFER FIG. 152)

Sl. No	*Rafter Section*		*MS Plate Size*	*Diameter of MS Rods*	*Number of MS Rods in Each Half*	*Number of MS Rods in One Row*	*Number of Rows*	*a*	*b*	*c*	*d*	*e*
	Width mm	*Depth mm*	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*
1	200	400	200 x 380 x 6	16	4	2	2	30	40	70	50	100
2	250	500	250 x 420 x 8	18	6	3	2	35	45	80	60	100
3	300	600	300 x 520 x 10	18	9	3	3	40	45	80	60	100
4	400	800	400 x 620 x 12	22	12	4	3	50	60	80	60	120
5	400	1000	400 x 640 x 16	25	12	4	3	50	65	80	60	120
6	500	800	500 x 640 x 12	25	12	4	3	50	65	80	60	120
7	500	900	500 x 560 x 14	28	10	5	2	60	70	90	70	120
8	500	1000	500 x 780 x 16	32	9	3	3	70	80	100	80	120
9	500	1200	500 x 810 x 18	32	12	4	3	70	80	100	80	150
10	500	1500	500 x 870 x 25	36	12	4	3	75	90	105	85	150
11	600	1100	600 x 810 x 18	32	12	4	3	70	80	100	80	150
12	600	1200	600 x 870 x 18	36	12	4	3	75	90	105	85	150
13	600	1500	600 x 750 x 25	42	10	5	2	80	110	110	90	150
14	750	1100	750 x 970 x 18	42	9	3	3	80	110	110	90	150
15	750	1300	750 x 970 x 20	42	12	4	3	80	110	110	90	150
16	750	1500	750 x 970 x 25	42	12	4	3	80	110	110	90	150

TABLE 143 ESTIMATION OF QUANTITIES

Frames with Hinged Bases

Bays	Span	Spacing	Column Height	Quantity of Concrete (m^3/m^2)		Quantity of Steel (kg/m^2)		
				In Frames	In Purlines, etc	Frames	Purlins, etc.	
	(m)	(m)	(m)			Hysd	Hysd	P.S.Steel
3	12	6	9.5	0.1538	0.0327	13.810	4.444	–
	12	12	5.0	0.0613	0.0688	5.039	5.396	2.153
	12	12	6.5	0.0665	0.0717	5.669	5.625	2.273
	12	12	9.5	0.0769	0.07748	7.882	6.079	2.514
	18	6	6.5	0.1071	0.0250	8.883	3.472	–
	18	6	9.5	0.1318	0.0268	11.571	3.694	–
	18	6	12.5	0.0710	0.0240	15.605	3.917	–
	18	12	6.5	0.0590	0.0652	5.556	5.108	2.022
	18	12	9.5	0.0776	0.0690	8.776	5.412	2.182
	18	12	12.5	0.1045	0.0729	10.546	5.716	2.343
4	9	6	5.0	0.0480	0.0285	7.958	3.953	–
	9	6	6.5	0.0923	0.0300	9.199	4.120	–
	9	12	5.0	0.0513	0.0741	4.604	5.810	2.306
	9	12	6.5	0.0562	0.0770	5.313	6.039	2.426
	12	6	5.0	0.0985	0.0270	7.823	3.781	–
	12	6	6.5	0.1069	0.0281	8.837	3.906	–
	12	6	9.5	0.1497	0.0301	13.132	4.156	–
	12	12	5.0	0.0602	0.0659	4.679	5.168	2.033
	12	12	6.5	0.0651	0.0681	5.797	5.339	2.123
	12	12	9.5	0.0878	0.0724	8.319	5.681	2.304

(Continued)

) :c P.S.Steel	d Bases f Steel (kg/m²) Purlins, et sd	ımes with Fixe Quantity oı es	Hy	:S – *Contd* Fra ı³/m²) Framerlines, etc Hysd	F QUANTITIE of Concrete (n In Pt	TIMATION O Quantity In Frames	ABLE 143 ES ght Column Hei (m)	T. acing (m)	Sp	Span (m)	Bays
–	39		4.2	18.90 0316	0.	0.1406	9.5	6		30	1
–	39		4.6	21.93 0350	0.	0.1573	12.5	6		30	
2.589	53	3	6.1	12.60 784	0	0.0703	9.5	12		30	
2.878	0	3	6.7	16.50 0853	0	0.0786	12.5	12		30	
–	48	6	4.6	3.29 .0346	0	0.0252	5.0	6		9	2
–	81	5	4.9	5.05 .0375	0	0.0445	6.5	6		9	
2.782	41	5	6.7	2.49 .0859	0	0.0283	5.0	12		9	
3.023	99	2	7.1	2.91 .0918	0	0.0321	6.5	12		9	
–	92	7	4.2	3.91 .0315	0	0.0504	5.0	6		12	2
–	42	2	4.5	4.72 .0337	0	0.0672	6.5	6		12	
–	49	9	5.0	7.13 .0381	(	0.0672	9.5	6		12	
2.545	78	8	6.2	2.78 .0801	(	0.0252	5.0	12		12	
2.726	22	0	6.6	3.66 .0845	(	0.2800	6.5	12		12	
3.083	13	0	7.3	5.91 .0933	(	0.0336	9.5	12		12	
–	55	28	3.7	8.02 .0274	(	0.0851	6.5	6		18	
–	88	28	4.0	99.5 0.0303	(	0.0984	9.5	6		18	
–	506	77	4.6	11.4 0.0332	(	0.1118	12.5	6		18	
2.222	495	19	5.4	5.0 0.0701		0.0426	6.5	12		18	
2.461	954	11	5.5	6.7 0.0759		0.0492	9.5	12		18	
2.701	412	19	6.4	8.4 0.0817		0.0559	12.5	12		18	

Continued) (

TABLE 143 ESTIMATION OF QUANTITIES – *Contd*

Frames with Fixed Bases

Bays	Span (m)	Spacing (m)	Column Height (m)	Quantity of Concrete (m^3/m^2)		Quantity of Steel (kg/m^2)		
				In Frames	In Purlines, etc	Frames	Purlins, etc	
						Hysd	Hysd	P.S.Steel
2	24	6	9.5	0.1373	0.0273	12.385	3.743	–
	24	6	12.5	0.1529	0.0295	16.351	3.993	–
	24	12	9.5	0.0687	0.0698	17.880	5.577	2.226
	24	12	12.5	0.0765	0.0742	9.578	5.818	2.406
3	9	6	5.0	0.0239	0.0306	3.265	4.198	–
	9	6	6.5	0.0420	0.0326	4.574	4.414	–
	9	12	5.0	0.0269	0.0781	2.290	6.123	2.466
	9	12	6.5	0.0303	0.0820	3.176	6.429	2.623
3	12	6	5.0	0.0483	0.0286	3.676	3.954	–
	12	6	6.5	0.0533	0.0301	4.481	4.125	–
	12	6	9.5	0.0633	0.0330	6.292	4.458	–
	12	12	5.0	0.0241	0.0742	2.789	5.815	2.306
	12	12	6.5	0.0266	0.0772	2.847	6.046	2.421
	12	12	9.5	0.0316	0.0830	5.148	6.507	2.664
	18	6	5.0	0.0819	0.0250	7.599	3.475	–
	18	6	6.5	0.0937	0.0269	9.145	3.698	–
	18	6	9.5	0.1056	0.0289	11.528	3.920	–
	18	12	5.0	0.0409	0.0652	4.823	5.113	2.022
	18	12	6.5	0.0469	0.0691	6.116	5.418	2.182
	18	12	9.5	0.0528	0.0730	8.163	5.724	2.341

(Continued)

TABLE 143 ESTIMATION OF QUANTITIES – *Contd*

Frames with Fixed/Hinged Bases

Bays	Span	Spacing	Column Height	Quantity of Concrete (m^3/m^2)		Quantity of Steel (kg/m^2)		
				In Frames	In Purlines, etc	Frames	Purlins, etc	
	(m)	(m)	(m)			Hysd	Hysd	P.S.Steel
4	9	6	5.0	0.0233	0.0287	3.153	3.968	–
	9	6	6.5	0.0408	0.0301	4.296	4.134	–
	9	12	5.0	0.0262	0.0742	2.431	5.815	2.306
	9	12	6.5	0.0294	0.0772	2.870	6.046	2.424
	12	6	5.0	0.0472	0.0271	3.490	3.788	–
	12	6	6.5	0.0519	0.0282	4.410	3.913	–
	12	6	9.5	0.0613	0.0304	6.003	4.163	–
	12	12	5.0	0.0236	0.0713	2.701	5.583	2.184
	12	12	6.5	0.0260	0.0735	3.184	5.757	2.274
	12	12	9.5	0.0307	0.0779	3.906	6.102	2.455
1	9	6	5.0	0.1007	0.0483	19.611	6.315	–
	9	6	6.5	0.1096	0.0541	12.519	6.981	–
	9	12	5.0	0.0611	0.1160	6.546	9.102	3.954
	9	12	65	0.0688	0.1276	7.056	10.019	4.426
	12	6	5.0	0.1154	0.0398	9.514	5.278	–
	12	6	6.5	0.1290	0.0440	11.792	5.778	–
	12	6	9.5	0.1868	0.0525	21.375	6.674	–
	12	12	5.0	0.0700	0.0971	6.104	7.625	3.264
	12	12	6.5	0.0778	0.0105	7.257	8.313	3.625
	12	12	9.5	0.1088	0.1231	11.236	9.681	4.347

(Continued)

d ITIES – *Cont*N OF QUANT ESTIMATIOI TABLE 143

/Fixed Bases ·s with Hinged, Frame

.Steel	Purlins, etc P.S	Hysd	Frames Hysd	es, etc .	In Purlin	Frames	In I	olumn Height (m)	g	Cc	Spacin (m)	Span (m)	Bays
–		5.028	15.285	31	0.03	1621	0.	9.5			6	12	2
.392	2	5.851	5.3194	46	0.07	0635	0.	5.0			12	12	
.573	2	6.194	6.309	39	0.07	0693	0.	6.5			12	12	
.934	2	6.878	8.674	76	0.08	0965	0.	9.5			12	12	
–		3.750	9.255	73	0.02	1107	0.	6.5			6	18	
–		4.079	12.861	01	0.03	1373	0.	9.5			6	18	
–		4.412	15.912	30	0.03	1792	0.	12.5			6	18	
.222	1	5.488	5.877	00	0.07	0608	0	6.5			12	18	
.463		5.944	7.972	57	0.07	.0807	0	9.5			12	18	
.701		6.398	10.264	15	0.08	.1093	0	12.5			12	18	
–		3.740	15.865	72	0.02	.1664	0	9.5			6	24	2
–		3.986	18.025	93	0.02	.1968	0	12.5			6	24	
2.227		5.469	9.646	97	0.06	.0900	0	9.5			12	24	
2.406		5.809	11.734	4	0.07	.1201	0	12.5			12	24	
–		4.173	8.265	04	0.03	.0858	0	5.0			6	9	3
–		4.395	9.086	23	0.03	.0947	0	6.5			6	9	
2.466		6.114	4.781	80	0.07	.0524	0	5.0			[illegible]	9	
2.627		6.420	5.565	19	0.08	.0576	[illegible]	6.5			[illegible]	9	
–		3.949	7.769	84	0.0	.1004	[illegible]	5.0			[illegible]	12	
–		4.111	9.120	98	0.0	.1094	[illegible]	6.5			[illegible]	12	

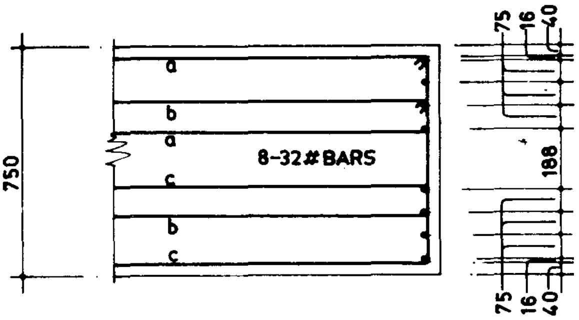
ntinued) (Co

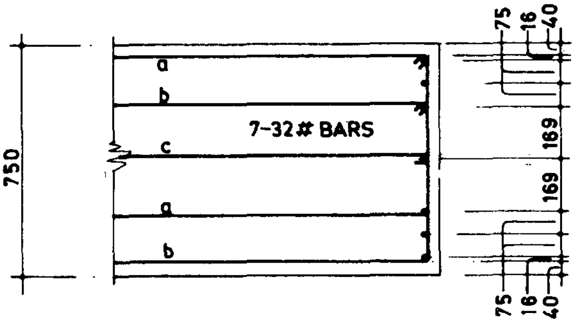
d ITIES – *Cont*N OF QUANT ESTIMATIO TABLE 143

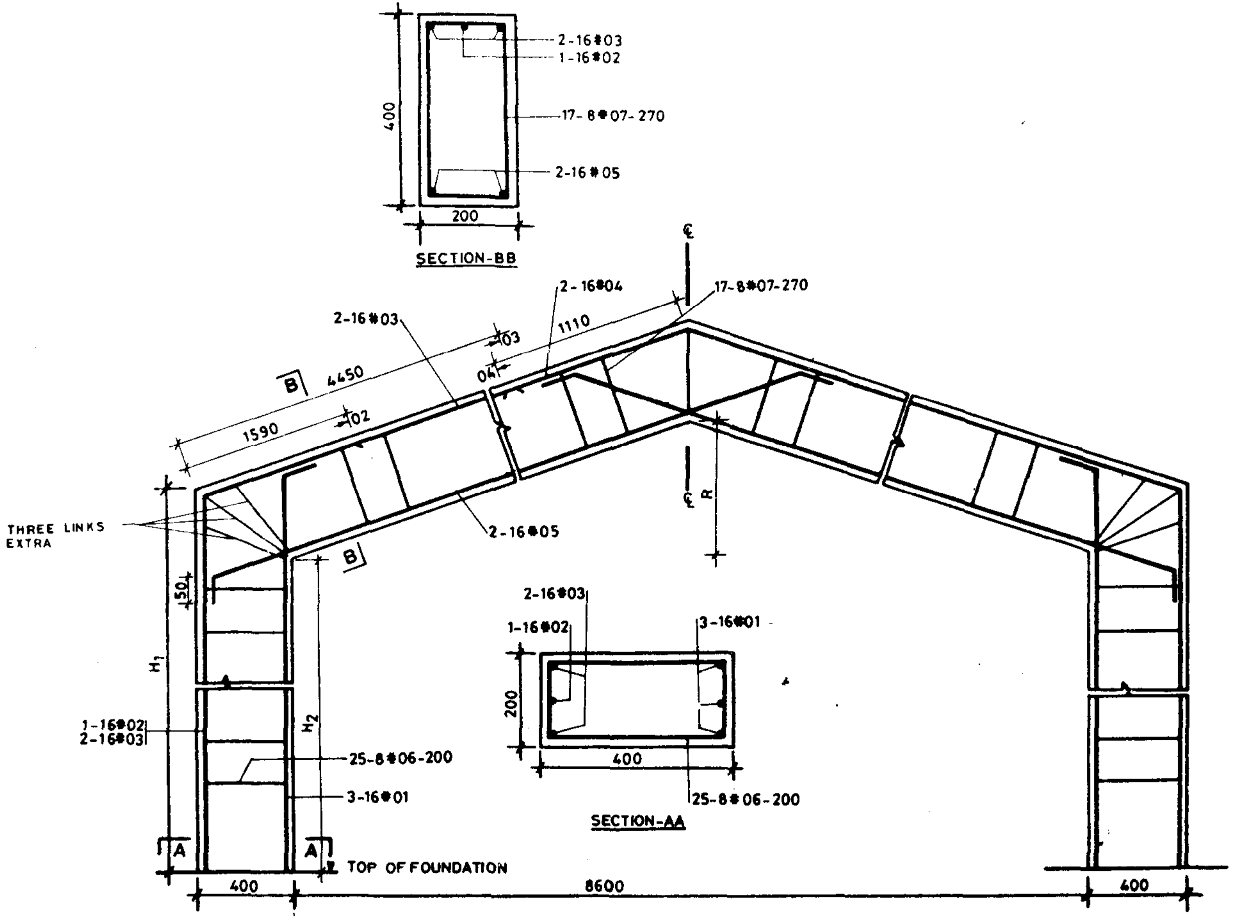
	'Fixed Bases	*s with Hinged*	*Frame*										
	el (kg/m^2)	Quantity of Ste		(n^2)	Concrete (m^3/n	Quantity of C		olumn Height	ıg	C	Spacir	Span	Bays
	Purlins, etc		Frames	ıs, etc	In Purli	Frames	In I						
.Steel	P.S	Hysd	Hysd					(m)			(m)	(m)	
–		4.444	13.810	7	0.032	1538	0.	9.5			6	12	3
.153	2.	5.396	5.039	8	0.068	0613	0.	5.0			12	12	
.273	2.	5.625	5.669	7	0.071	0665	0.	6.5			12	12	
.514	2.	6.079	7.882	48	0.077	0769	0.	9.5			12	12	
–		3.472	8.883	50	0.025	1071	0.	6.5			6	18	
–		3.694	11.571	58	0.026	1318	0.	9.5			6	18	
–		3.917	15.605	40	0.024	1710	0.	12.5			6	18	
.022	2	5.108	5.556	52	0.06	0590	0.	6.5			12	18	
.182	2	5.412	8.776	90	0.06	0776	0.	9.5			12	18	
.343	2	5.716	10.546	29	0.07	1045	0	12.5			12	18	
–		3.953	7.958	85	0.02	.0840	0	5.0			6	9	4
–		4.120	9.199	00	0.03	.0923	0	6.5			6	9	
2.306		5.810	4.604	41	0.07	.0513	0	5.0			12	9	
2.426		6.039	5.313	70	0.07	.0562	0	6.5			12	9	
–		3.781	7.823	70	0.02	.0985	0	5.0	5		6	12	
–		3.906	8.837	81	0.02	.1069	C	6.5	5		6	12	
–		4.156	13.132	01	0.03	.1497	(	9.5	5		(	12	
2.033		5.168	4.679	59	0.06	.0602	(	5.0	2		1	12	
2.123		5.339	5.797	81	0.06	.0651	(	6.5	2		1	12	
2.034		5.681	8.319	724	0.0	.0878	(	9.5	2		1	12	

General Notes for Figures 1 to 156

1. *Notation*
   a) 4–16   101 indicates four 16 mm diameter, HSD bars, type 01;
   b) 26–6 ϕ 03–250 indicates twenty six 6 mm diameter, MS bars, type 03 at spacing 250 mm centre-to-centre;
   c) ℄ indicates centre line; and
   d) ϕ indicates diameter.
2. All dimensions are in mm.
3. Maximum size of aggregates shall be:
   a) 12 mm for structures thickness less than 150 mm like purlins and cladding runners, and
   b) 20 mm for other members.
4. Clear cover to reinforcement shall be according to IS : 456-1978
5. Anchorage length, lap length, splicing, spacer bars, etc, shall be provided according to IS:456-1978.
6. Reinforcement details are symmetrical about the centre line of portals.
7. Bars shall be suitably joggled at the junction of column and beam and at crown of portal to avoid clashing of bars with each other.
8. The column height specified includes 0.5 m length of column which is assumed below ground level. However, if firm strata is not available at this depth, then a pedastal can be designed and constructed as indicated in 6.5.4.
9. For other details, refer to IS:456-1978 for RCC members and IS : 1343-1980 for Prestressed concrete members.
10. If exact size of bars is not available, they may be suitably replaced keeping the total area of reinforcement same.
11. Where extra width of column is available, the maximum spacing of corner column bars may be restricted to 75 mm (as shown in given figure below) so as to reduce the number of ties.







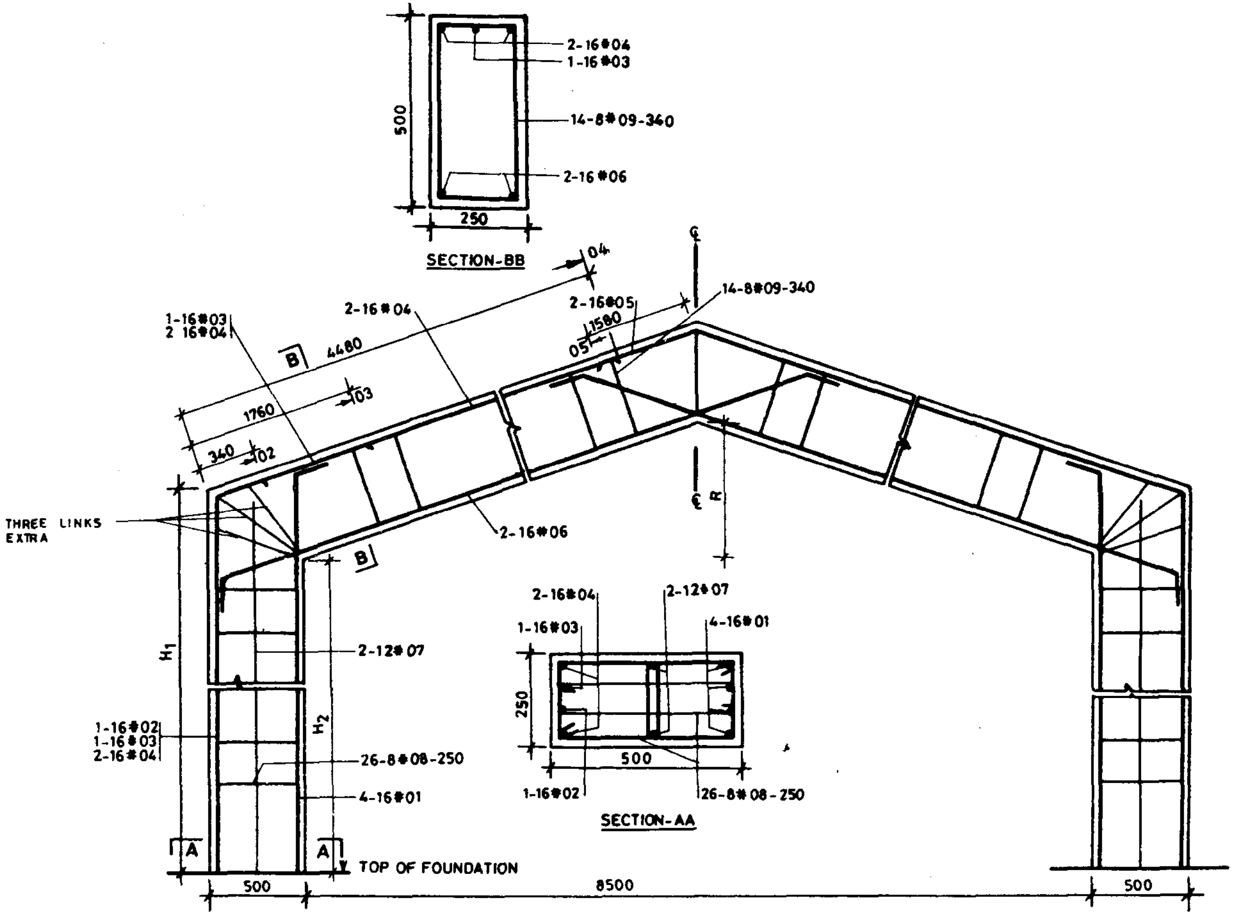
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS PRINCIPAL RAFTER	
				No. OF PURLINS	SPACING
1 in 3	5144	4856	1433	5	1139
1 in 4	5156	4844	1075	5	1111
1 in 5	5164	4836	860	5	1098

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 1
3. DISTACE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300

DRAWING No. 1 (REFER TABLE 1)

No. OF BAYS : ONE
SPAN : 9.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 5.0 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415



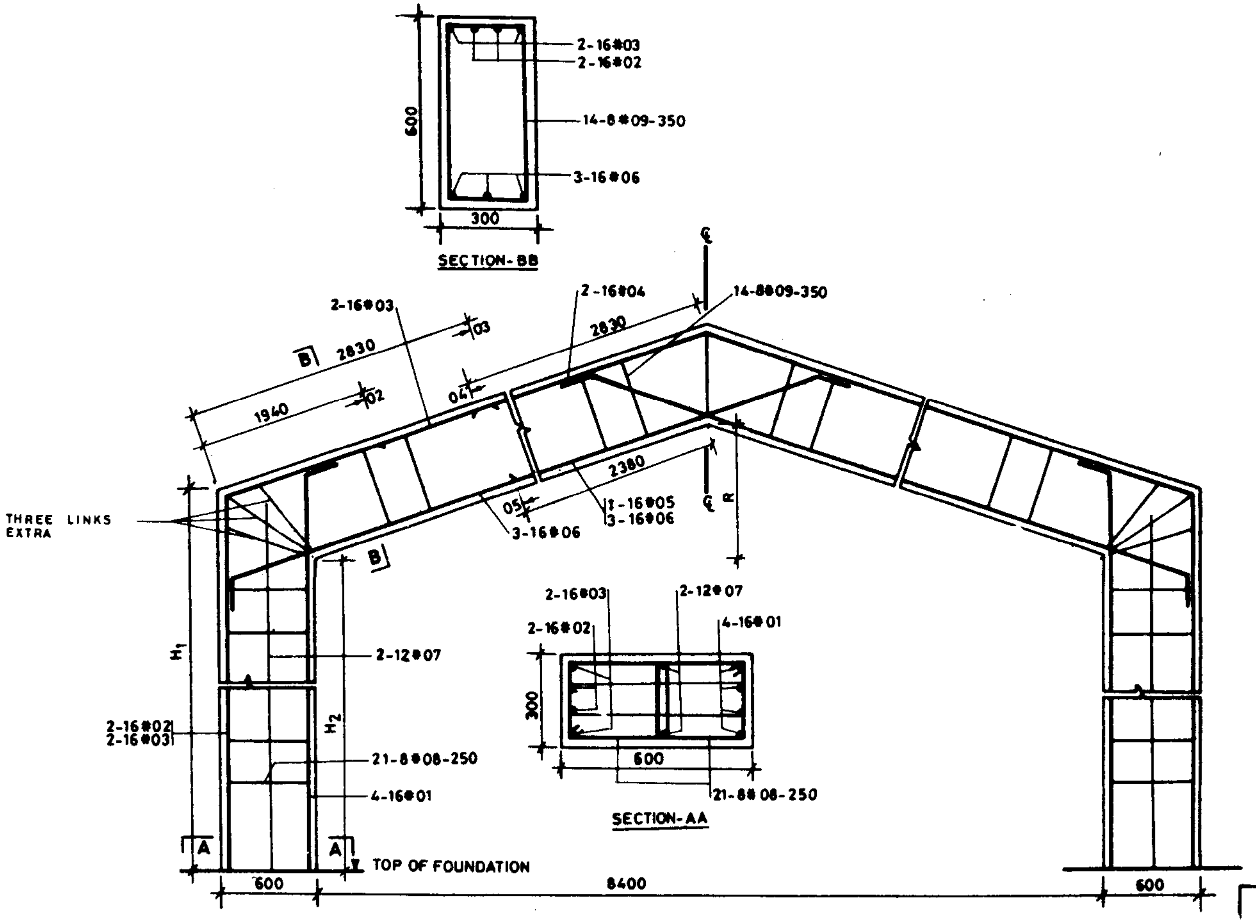
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS	
				PRINCIPAL RAFTER	
				No. OF PURLINS	SPACING
1 in 3	6680	6320	1417	5	1151
1 in 4	6695	6305	1063	5	1124
1 in 5	6705	6295	850	5	1111

NOTE:

1. ALL DIMENSIONS IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 2
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300

DRAWING No. 2 (REFER TABLE 2)

No. OF BAYS	: ONE
SPAN	: 9.0 m
SPACING	: 6.0 m
COLUMN HEIGHT	: 6.5 m
SUPPORT CONDITION	: FIXED
FOR ALL WIND AND SEISMIC ZONES	
MATERIALS:	
CONCRETE	: M 25
STEEL	: Fe 415



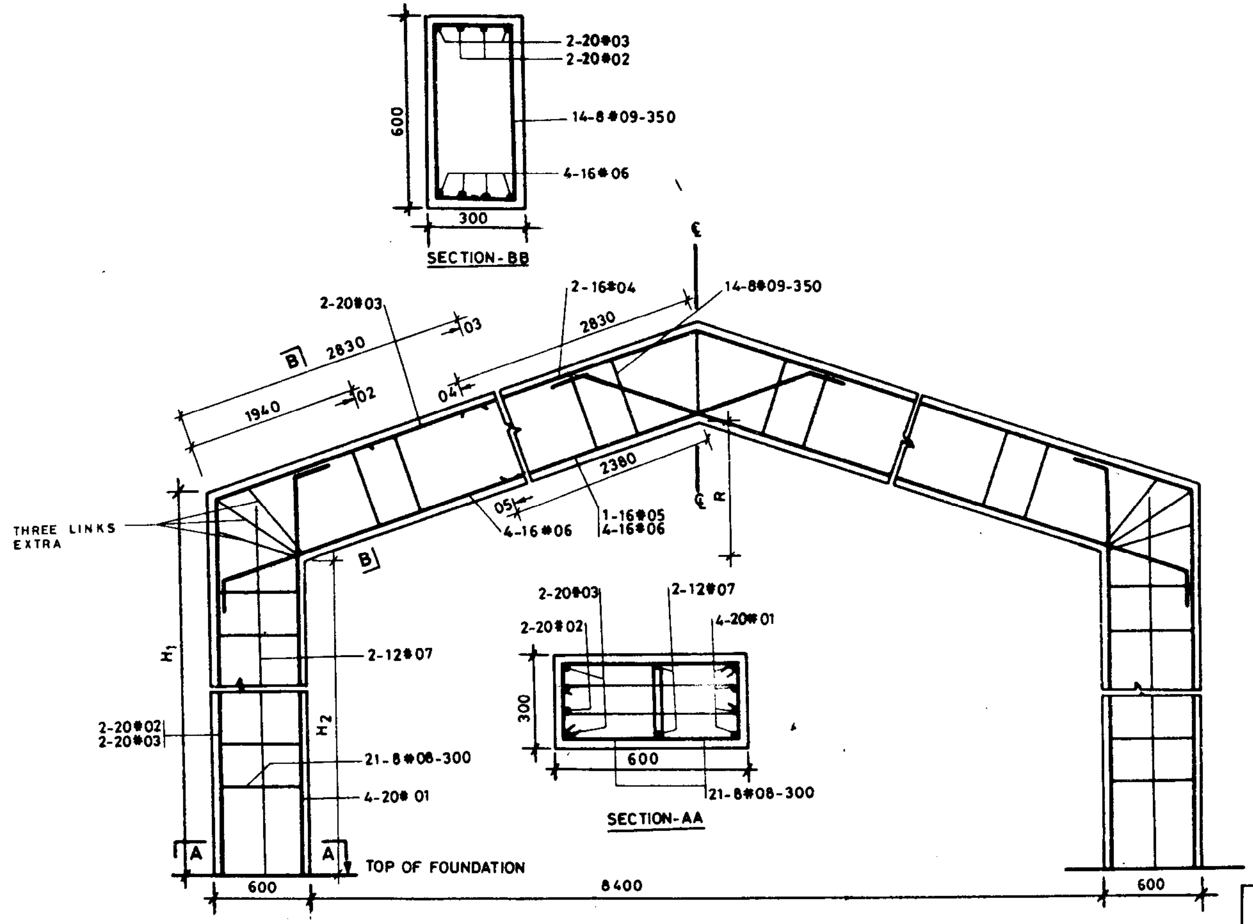
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS	
				PRINCIPAL RAFTER	
				No. OF PURLINS	SPACING
1 in 3	5217	4784	1400	5	1150
1 in 4	5234	4766	1050	5	1122
1 in 5	5246	4754	840	5	1109

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE: 3
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE: 100
   b. RIDGE : 360

DRAWING No. 3 (REFER TABLE 3)

No. OF BAYS : ONE
SPAN : 9.0 m
SPACING : 12.0 m
COLUMN HEIGHT : 5.6 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415



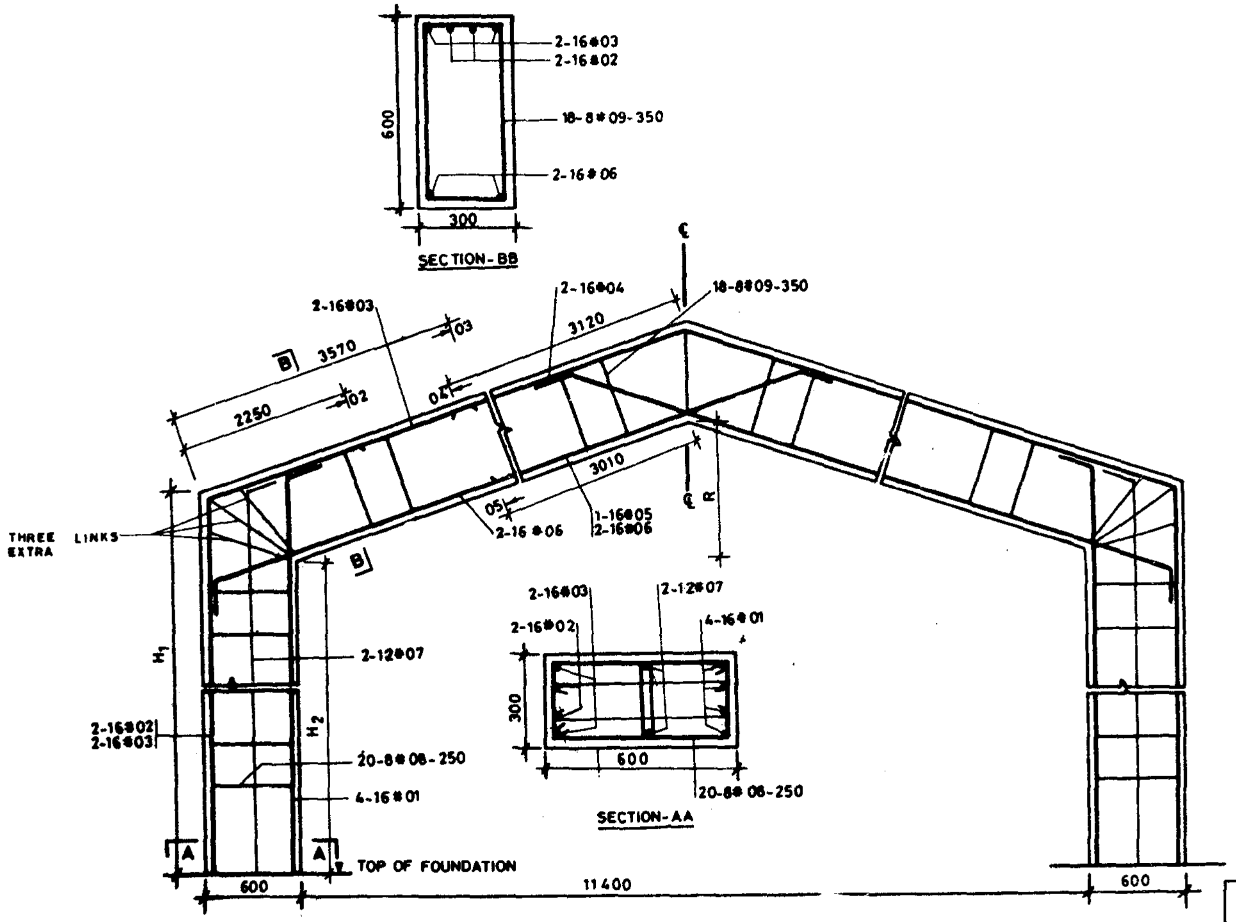
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS	
				PRINCIPAL RAFTER	
				No. OF PURLINS	SPACING
1 in 3	6717	6284	1400	5	1150
1 in 4	6734	6266	1050	5	1122
1 in 5	6746	6254	840	5	1109

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 4
3. DISTANCE OF THE NEAREST PURLIN LUG(℄) FROM THE a. EXTERNAL COLUMN FACE: 100
   b. RIDGE : 360

DRAWING No. 4 (REFER TABLE 4)

No. OF BAYS : ONE
SPAN : 9.0m
SPACING : 12.0m
COLUMN HEIGHT : 6.5m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415



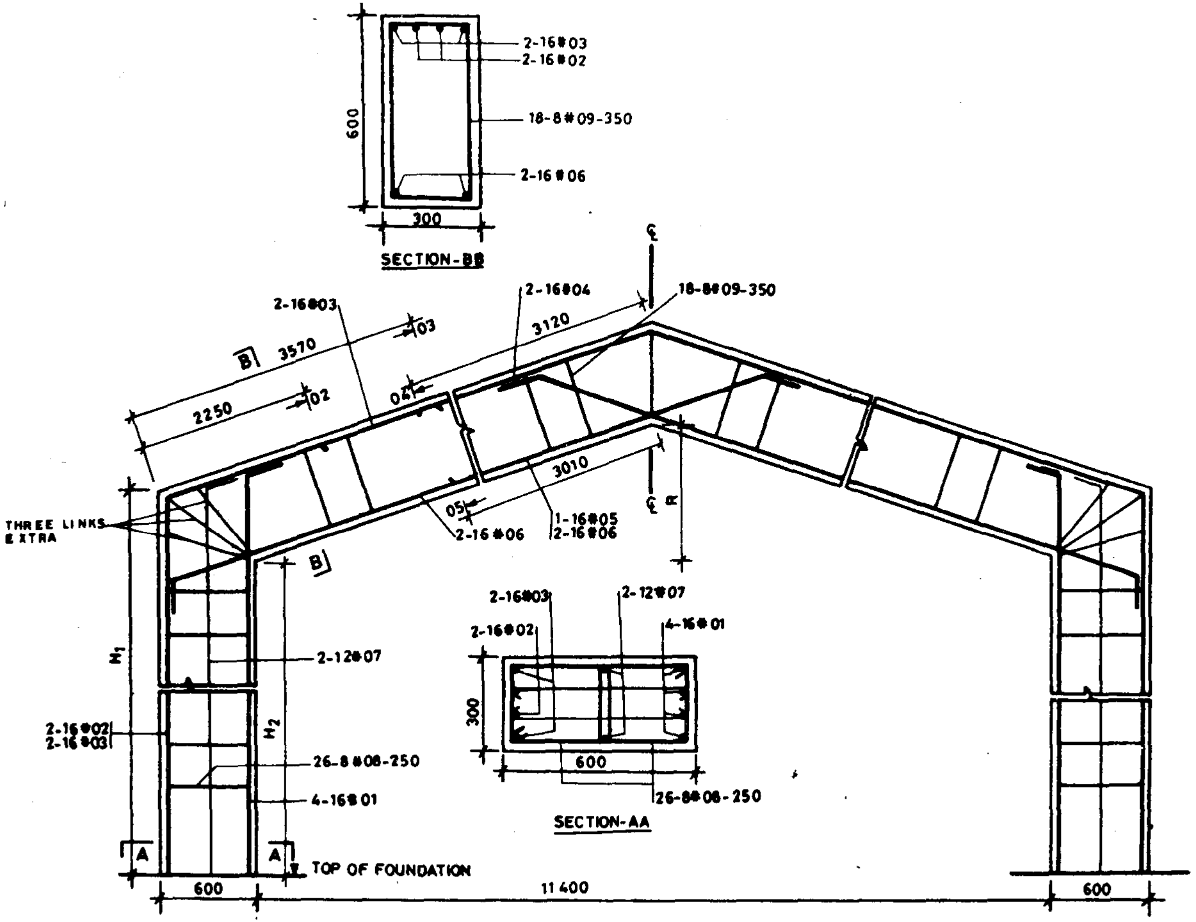
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS	
				PRINCIPAL RAFTER	
				No. OF PURLINS	SPACING
1 in 3	5217	4784	1900	6	1248
1 in 4	5234	4766	1425	6	1219
1 in 5	5246	4754	1140	6	1205

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE: 5
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300

DRAWING No. 5 (REFER TABLE 5)

No. OF BAYS : ONE
SPAN : 12.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 5.0 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415



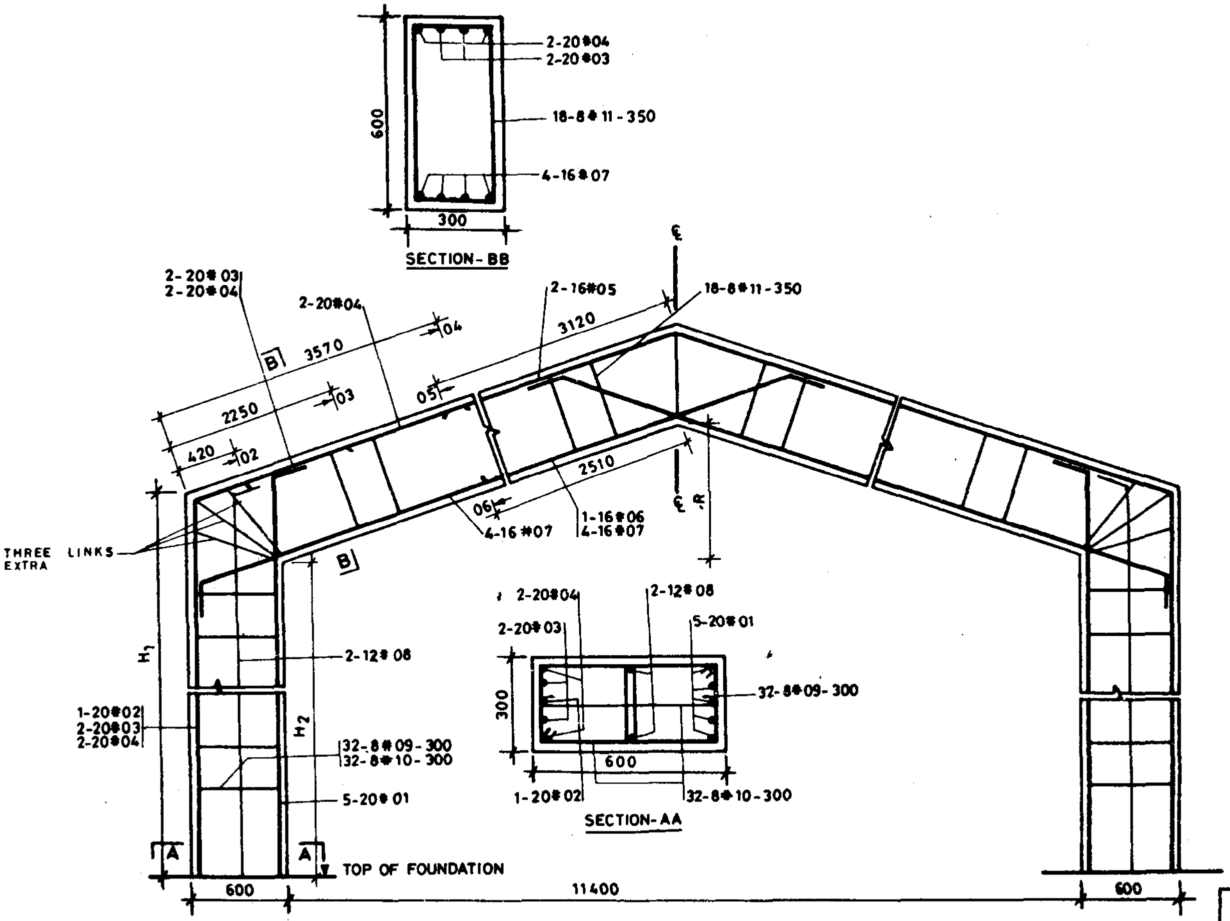
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS	
				PRINCIPAL RAFTER	
				No. OF PURLINS	SPACING
1 in 3	6717	6284	1900	6	1248
1 in 4	6734	6266	1425	6	1219
1 in 5	6746	6254	1140	6	1205

NOTE :

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 6
3. DISTANCE OF THE NEAREST PURLINS LUG (℄) FROM THE a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300

DRAWING No. 6 (REFER TABLE 6)

No. OF BAYS : ONE
SPAN : 12.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 6.5 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415



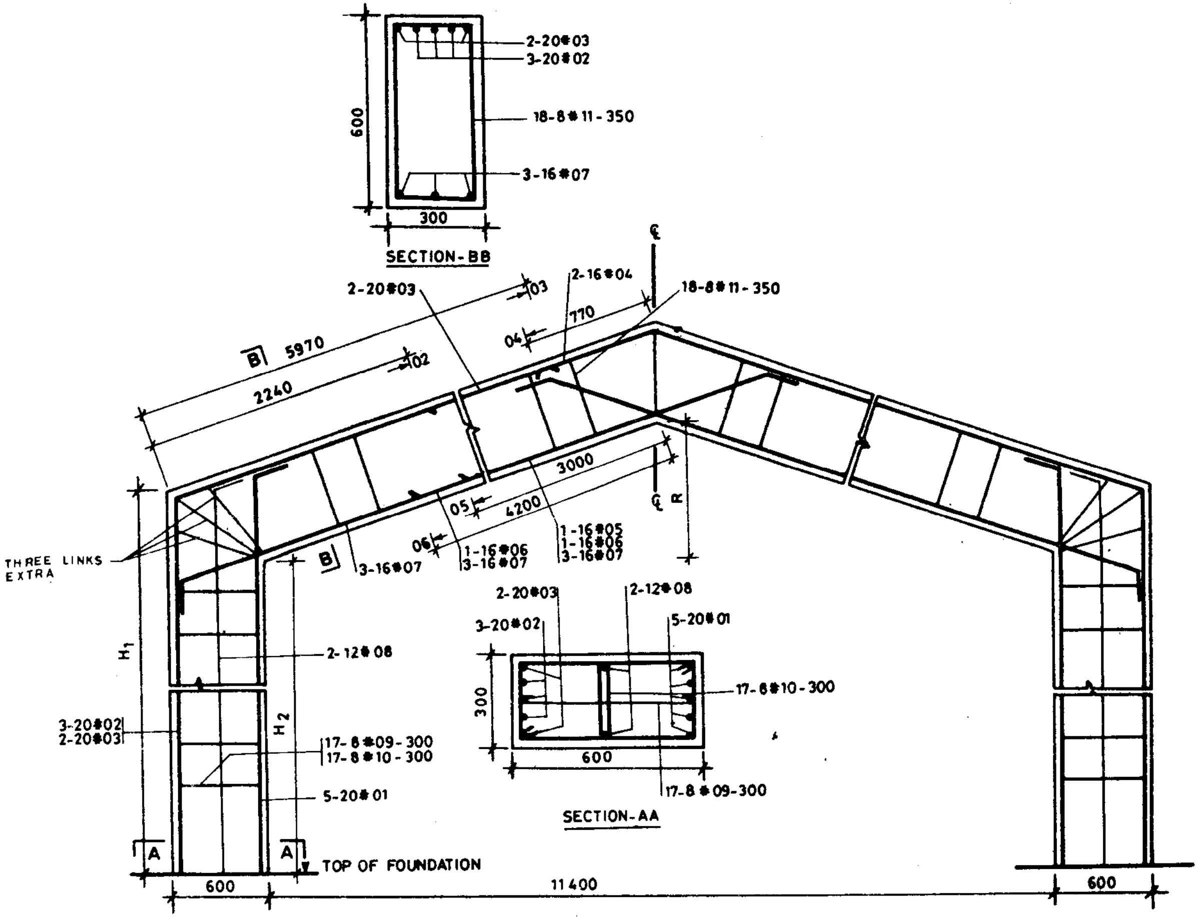
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS	
				PRINCIPAL RAFTER	
				No. OF PURLINS	SPACING
1 in 3	9717	9284	1900	6	1248
1 in 4	9734	9266	1425	6	1219
1 in 5	9746	9254	1140	6	1205

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE: 7
3. DISTANCE OF THE NEAREST PURLIN LUG(℄) FROM THE a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300

DRAWING No. 7 (REFER TABLE 7)

No. OF BAYS	: ONE
SPAN	: 12.0 m
SPACING	: 6.0 m
COLUMN HEIGHT	: 9.5 m
SUPPORT CONDITION FOR ALL WIND AND SEISMIC ZONES	: FIXED
MATERIALS:	
CONCRETE	: M 25
STEEL	: Fe 415



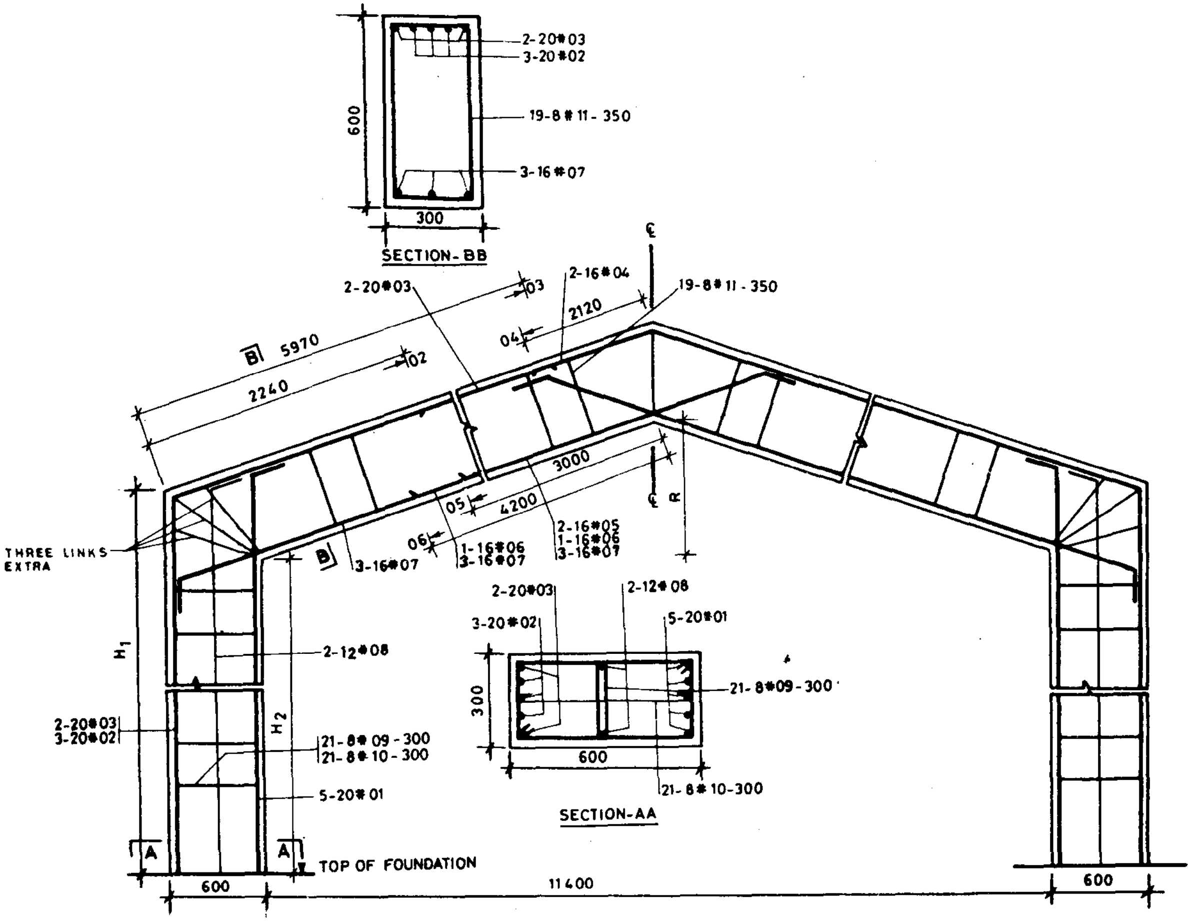
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS PRINCIPAL RAFTER No. OF PURLINS	 SPACING
1 in 3	5217	4784	1900	6	1236
1 in 4	5234	4766	1425	6	1207
1 in 5	5246	4754	1140	6	1193

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE: 8
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360

DRAWING No. 8 (REFER TABLE 8)

No. OF BAYS	: ONE
SPAN	: 12.0 m
SPACING	: 12.0 m
COLUMN HEIGHT	: 5.0 m
SUPPORT CONDITION	: FIXED
FOR ALL WIND AND SEISMIC ZONES	
MATERIALS:	
CONCRETE	: M 25
STEEL	: Fe 415



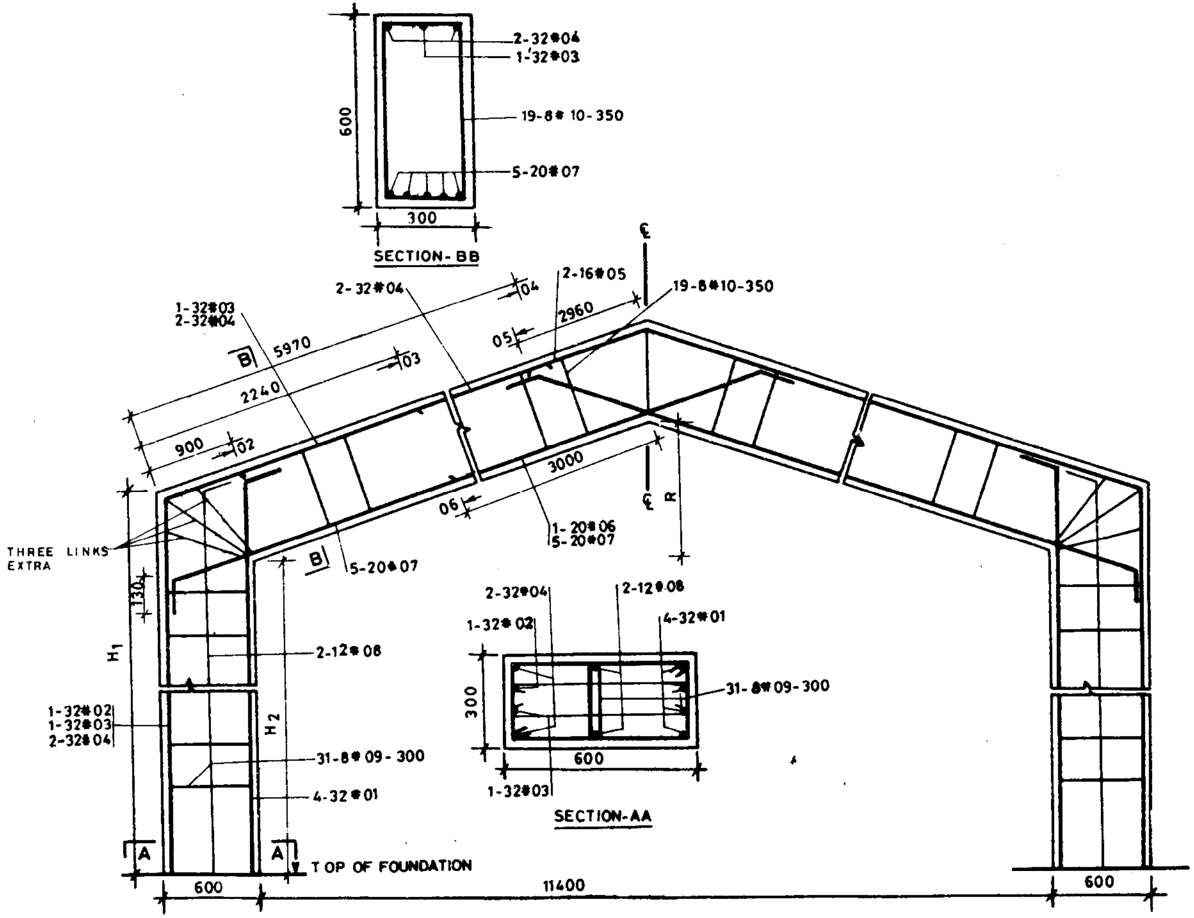
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS	
				PRINCIPAL RAFTER	
				No. OF PURLINS	SPACING
1 in 3	6717	6284	1900	6	1236
1 in 4	6734	6266	1425	6	1207
1 in 5	6746	6254	1140	6	1193

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE: 9
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE: 100
   b. RIDGE : 360

DRAWING No. 9 (REFER TABLE 9)

No. OF BAYS : ONE
SPAN : 12.0 m
SPACING : 12.0 m
COLUMN HEIGHT : 6.5 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415



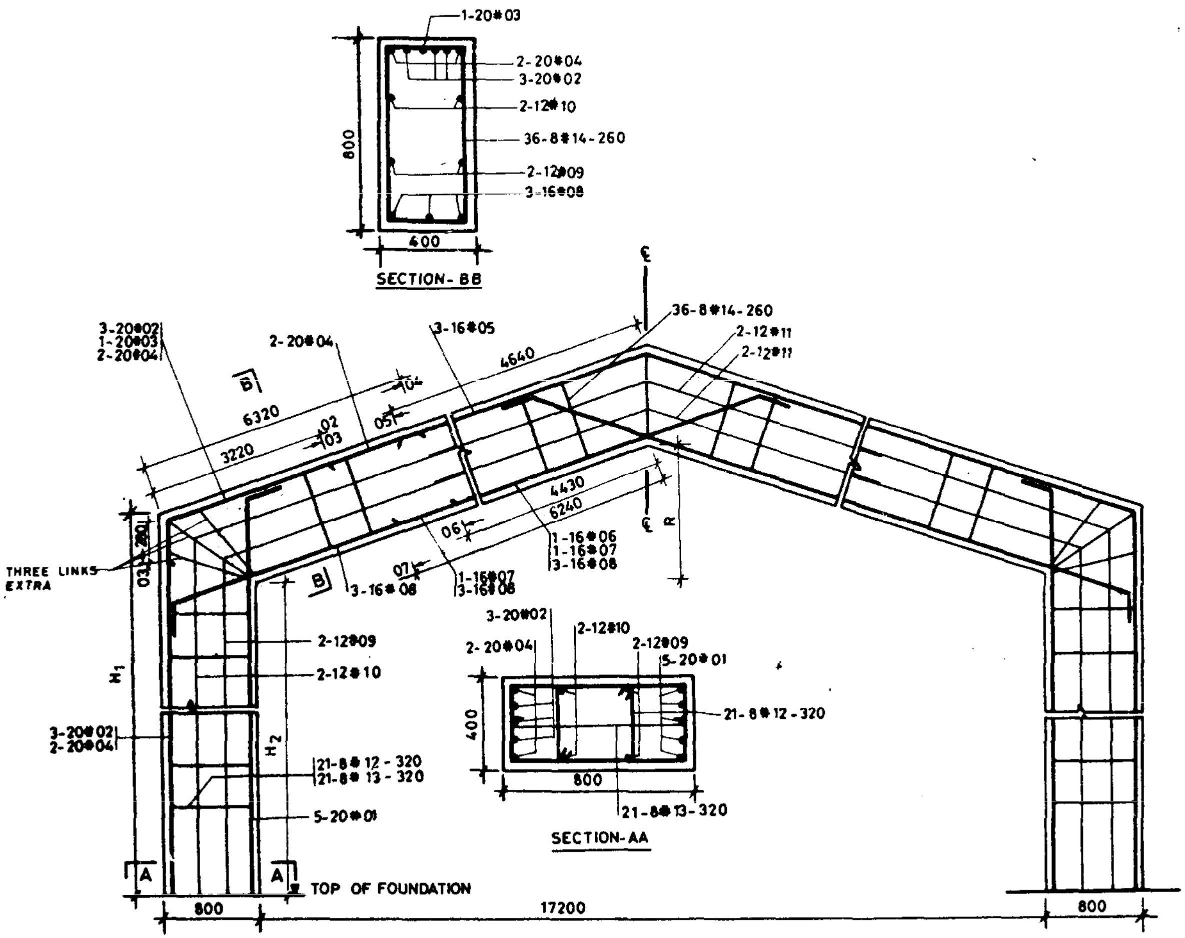
SLOPE	H1	H2	R	No. AND SPACING OF PURLINS	
				PRINCIPAL RAFTER	
				No. OF PURLINS	SPACING
1 in 3	9717	9284	1900	6	1236
1 in 4	9734	9266	1425	6	1207
1 in 5	9746	9254	1140	6	1193

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE: 10
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360

DRAWING No. 10 (REFER TABLE 10)

No. OF BAYS : ONE
SPAN : 12.0 m
SPACING : 12.0 m
COLUMN HEIGHT : 9.5 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415



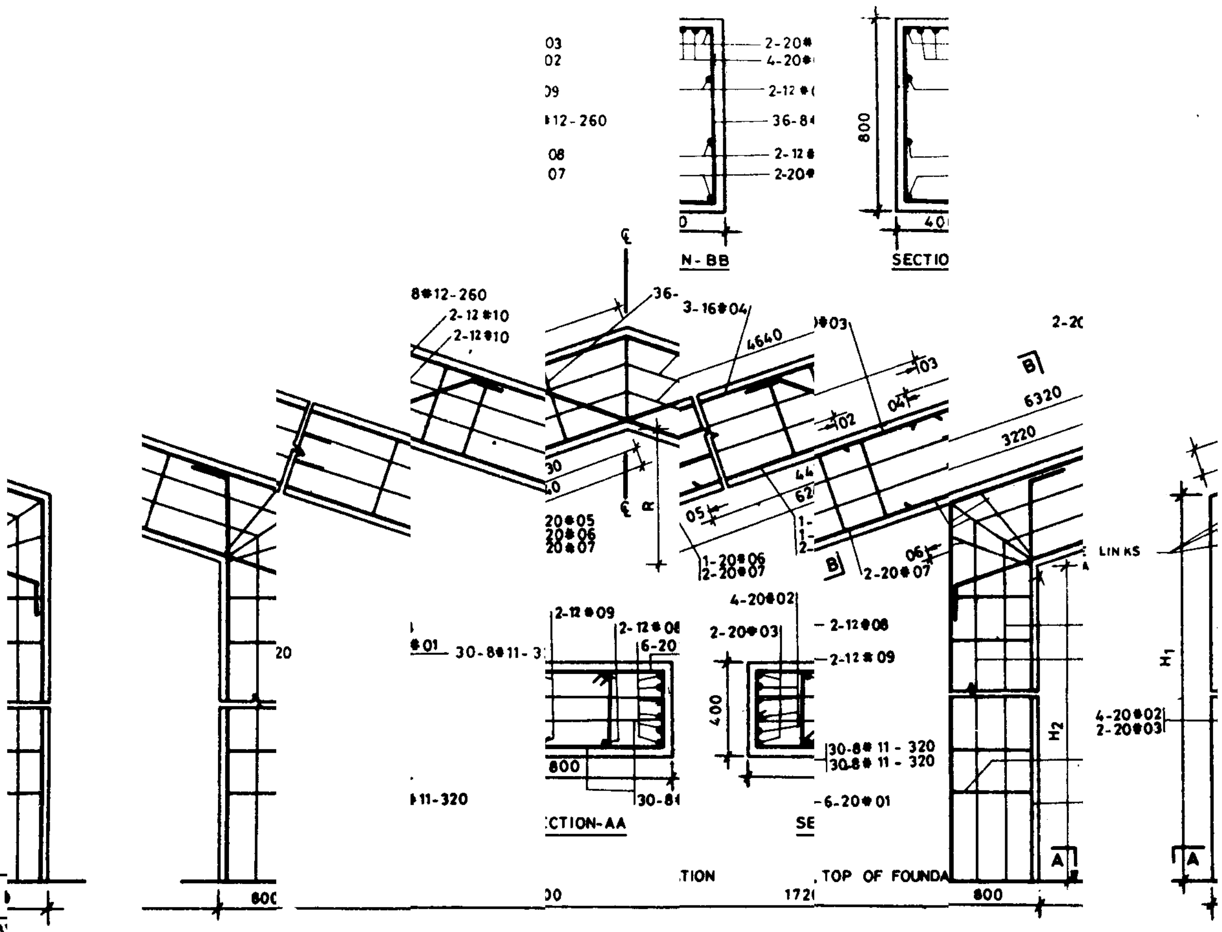
SLOPE	HH_1	H_2	R	No. AND SPACING OF PURLINS — PRINCIPAL RAFTER — No. OF PURLINS	No. AND SPACING OF PURLINS — PRINCIPAL RAFTER — SPACING
1 in 3	6789	6212	2867	8	1358
1 in 4	6813	6188	2150	8	1327
1 in 5	6828	6172	1720	8	1312

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 11
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300

DRAWING No. 11 (REFER TABLE 11)

No. OF BAYS	: ONE
SPAN	: 18.0 m
SPACING	: 6.0 m
COLUMN HEIGHT	: 6.5 m
SUPPORT CONDITION	: FIXED
FOR ALL WIND AND SEISMIC ZONES	
MATERIALS:	
CONCRETE	: M 25
STEEL	: Fe 415



2)

FER TABLE 1 No. 12 (REF

DRAWING

ONE
18.0 m
6.0 m
9.5 m
FIXED

M 25
Fe 415

YS :
:
:
EIGHT :
ONDITION :
WIND AND ZONES]
S:
E :
:

No. OF BA
SPAN
SPACING
COLUMN HI
SUPPORT C
FOR ALL V
SEISMIC
MATERIALS
CONCRETE
STEEL

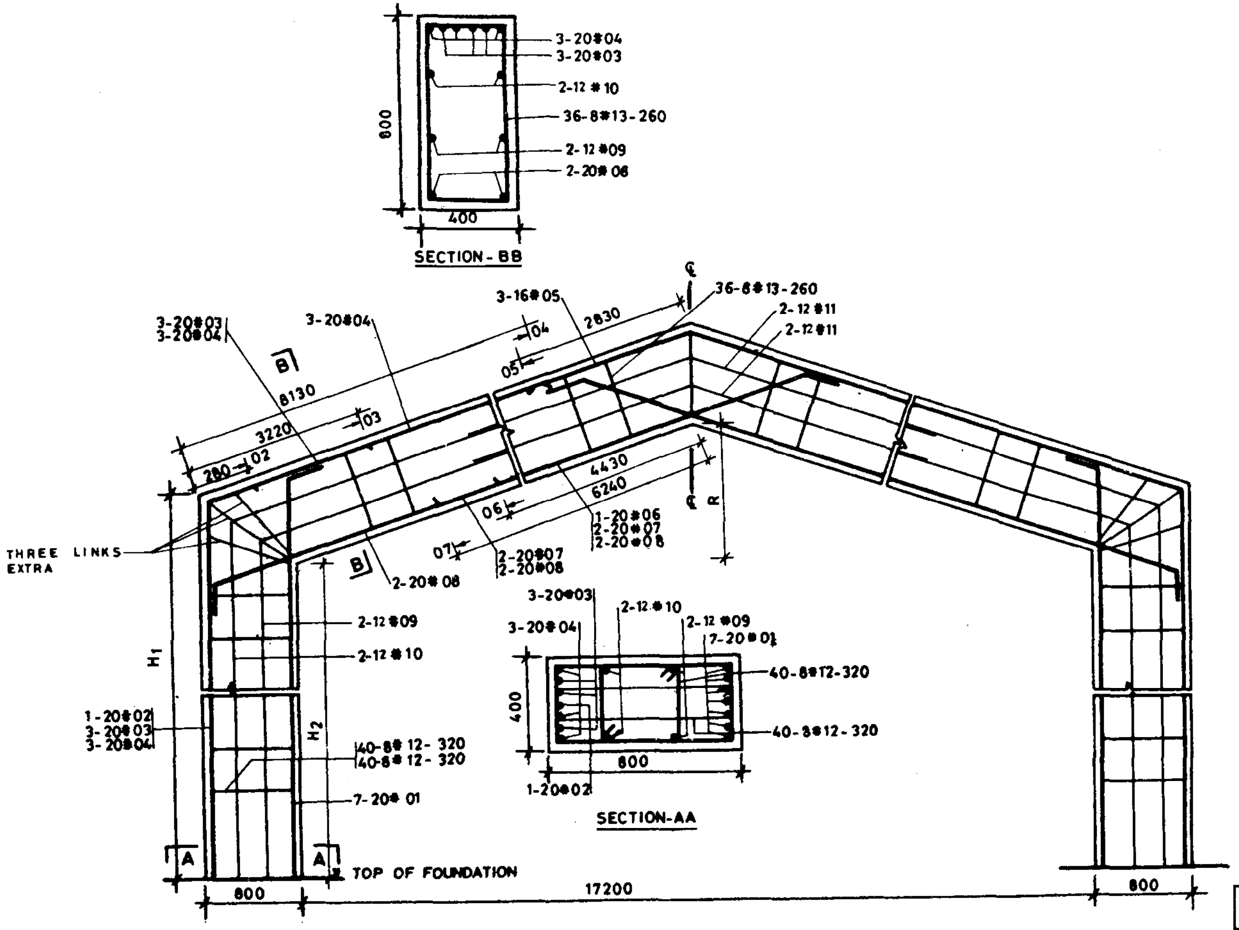
R TO
IRLIN LUG (℄)
N FACE : 100
: 300

NOTE :
ARE IN mm LL DIMENSIONS
FORCES REFEOR FOUNDATION
E : 12 NALYSIS TABL
HE NEAREST PUISTANCE OF TI
KTERNAL COLUMROM THE a. E
IDGE b. R

1. A R
2. F
A
3. D

SPACING RLINS RAFTER SPACING		No. AND OF PU PRINCIPAL No. OF PURLINS	H1	H2		SLOPE	
1358	367	8	789	9212	2	1 in 3	9
1327	F150	8	813	9188	2	1 in 4	9
1312	720	8	828	9172	1	1 in 5	9

THREE
EXTR.



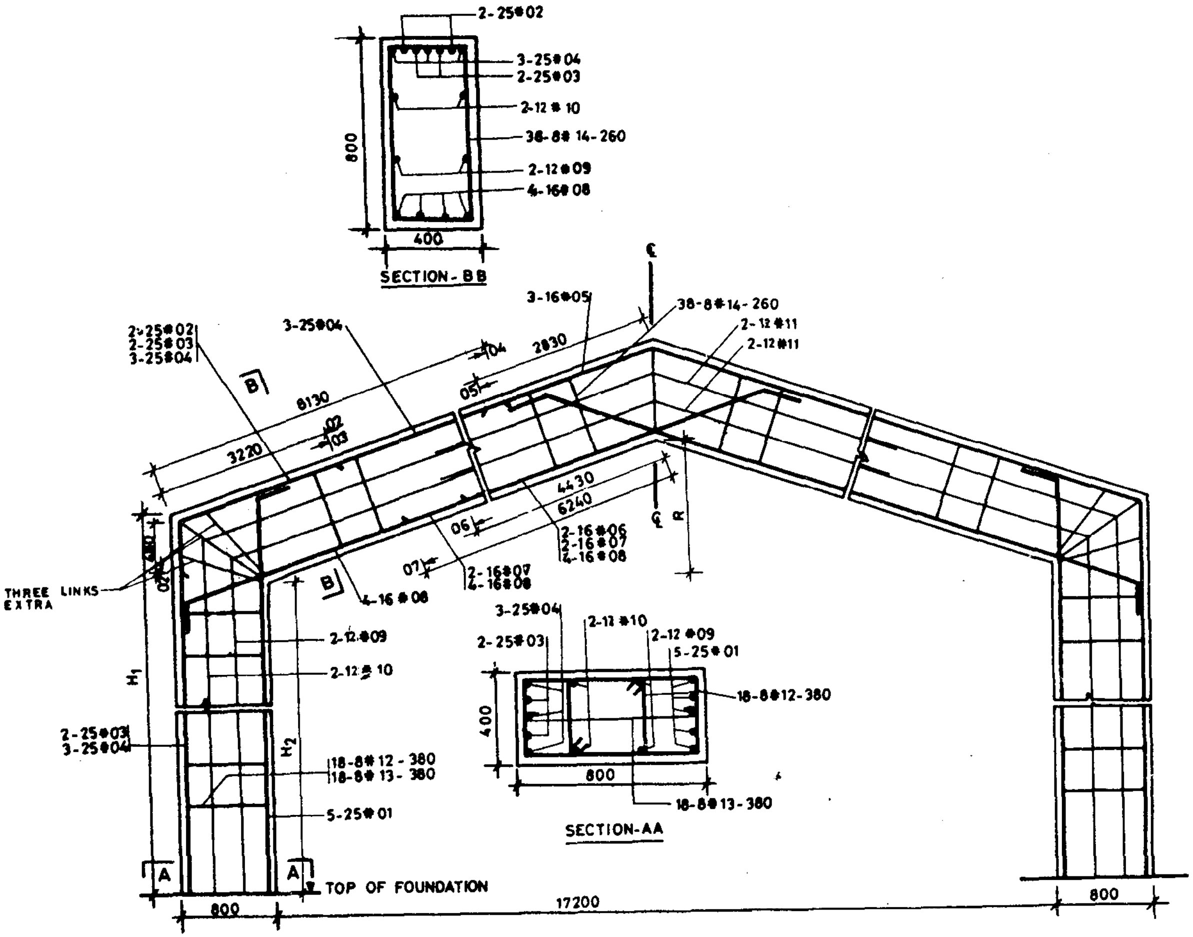
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS	
				PRINCIPAL RAFTER	
				No. OF PURLINS	SPACING
1 in 3	12789	12212	2867	8	1358
1 in 4	12813	12188	2150	8	1327
1 in 5	12828	12172	1720	8	1312

NOTE:

1. ALL DIMENSIONS ARE IN *mm*
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 13
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300

DRAWING No. 13 (REFER TABLE 13)

No. OF BAYS : ONE
SPAN : 18.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 12.5 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415



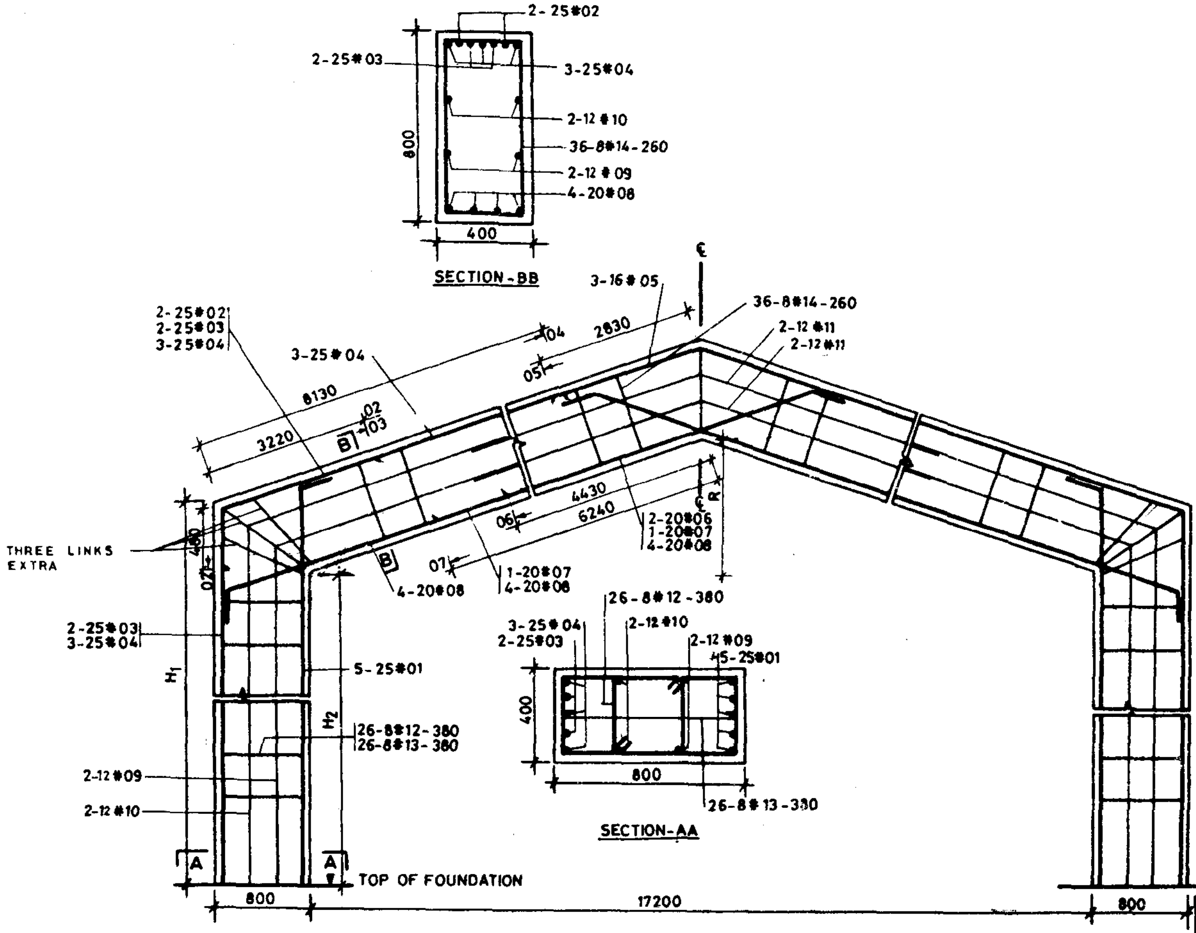
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS PRINCIPAL RAFTER No. OF PURLINS	SPACING
1 in 3	6789	6212	2867	8	1350
1 in 4	6813	6188	2150	8	1319
1 in 5	6828	6172	1720	8	1304

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 14
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360

DRAWING No. 14 (REFER TABLE 14)

No. OF BAYS	: ONE
SPAN	: 18.0 m
SPACING	: 12.0 m
COLUMN HEIGHT	: 6.5 m
SUPPORT CONDITION	: FIXED
FOR ALL WIND AND SEISMIC ZONES	
MATERIALS:	
CONCRETE	: M 25
STEEL	: Fe 415



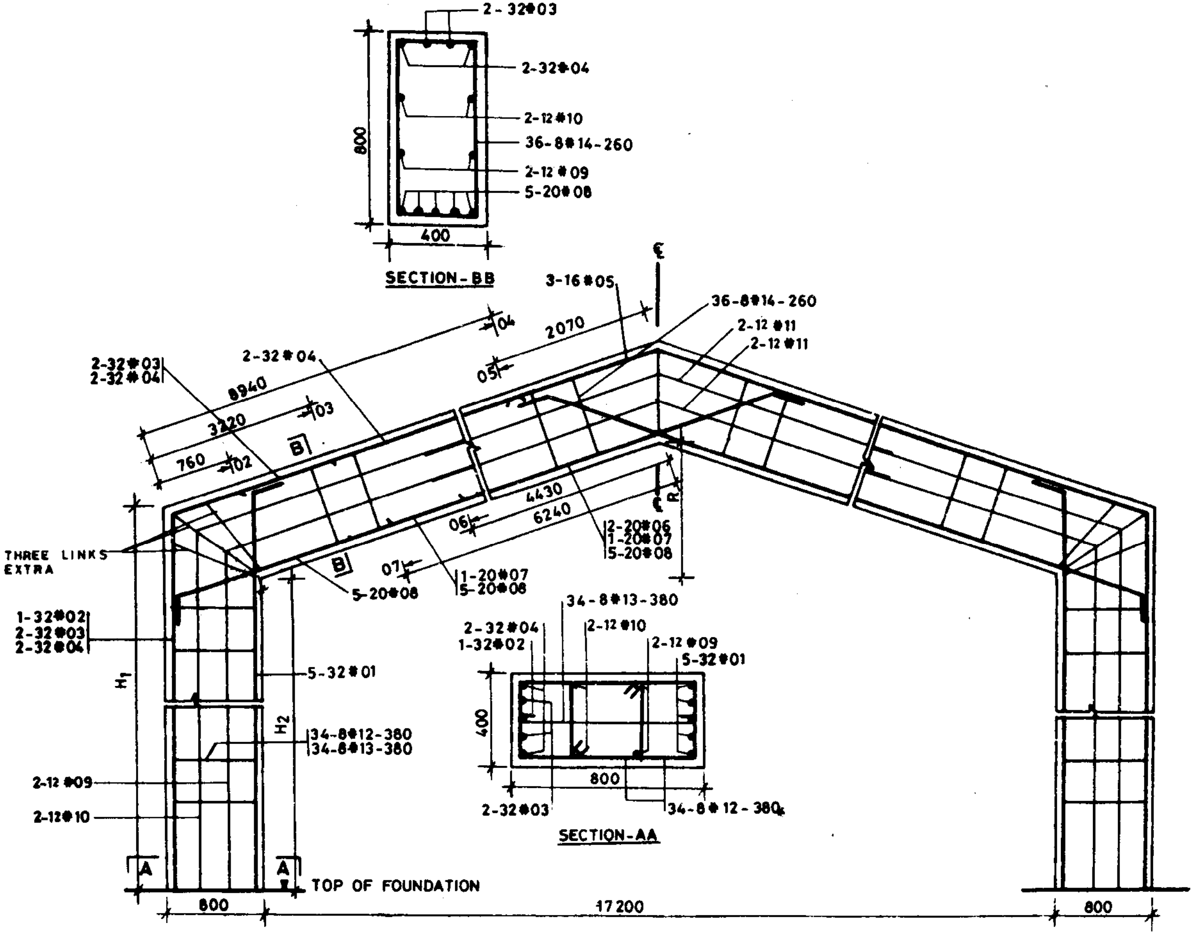
SLOPE	H1	H2	R	No. AND SPACING OF PURLINS PRINCIPAL RAFTER No. OF PURLINS	SPACING
1 in 3	9789	9135	2944	8	1350
1 in 4	9813	9106	2233	8	1319
1 in 5	9828	9086	1806	8	1304

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE: 15
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE: 100
   b. RIDGE: 360

DRAWING No. 15 (REFER TABLE 15)

No. OF BAYS	:	ONE
SPAN	:	18.0m
SPACING	:	12.0m
COLUMN HEIGHT	:	9.5m
SUPPORT CONDITION	:	FIXED
FOR ALL WIND AND SEISMIC ZONES		
MATERIALS:		
CONCRETE	:	M 25
STEEL	:	Fe415



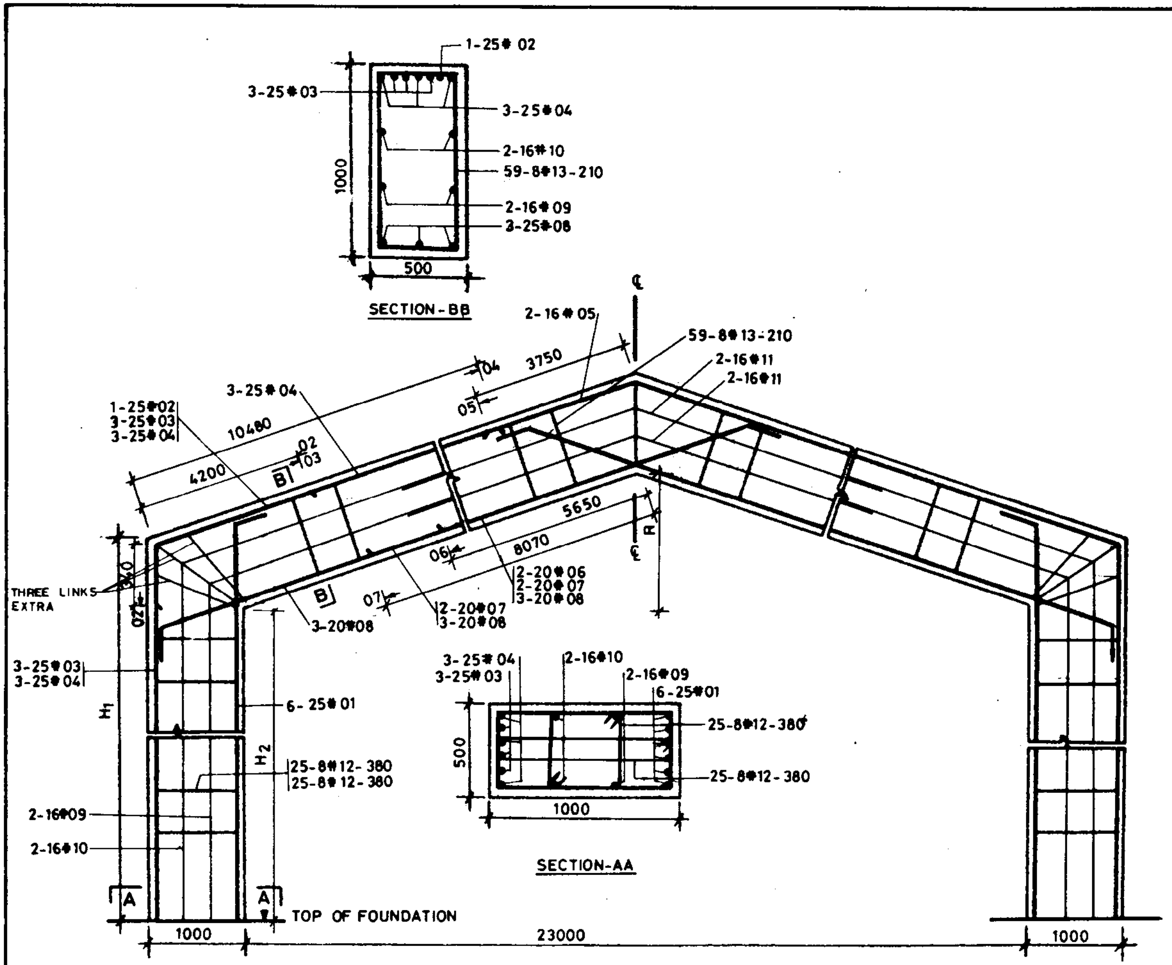
SLOPE	H1	H2	R	No. AND SPACING OF PURLINS PRINCIPAL RAFTER No. OF PURLINS	 SPACING
1 in 3	12789	12212	2867	8	1350
1 in 4	12813	12188	2150	8	1319
1 in 5	12828	12172	1720	8	1304

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE:16
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360

DRAWING No. 16 (REFER TABLE 16)

No. OF BAYS : ONE
SPAN : 18.0 m
SPACING : 12.0 m
COLUMN HEIGHT : 12.5 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415



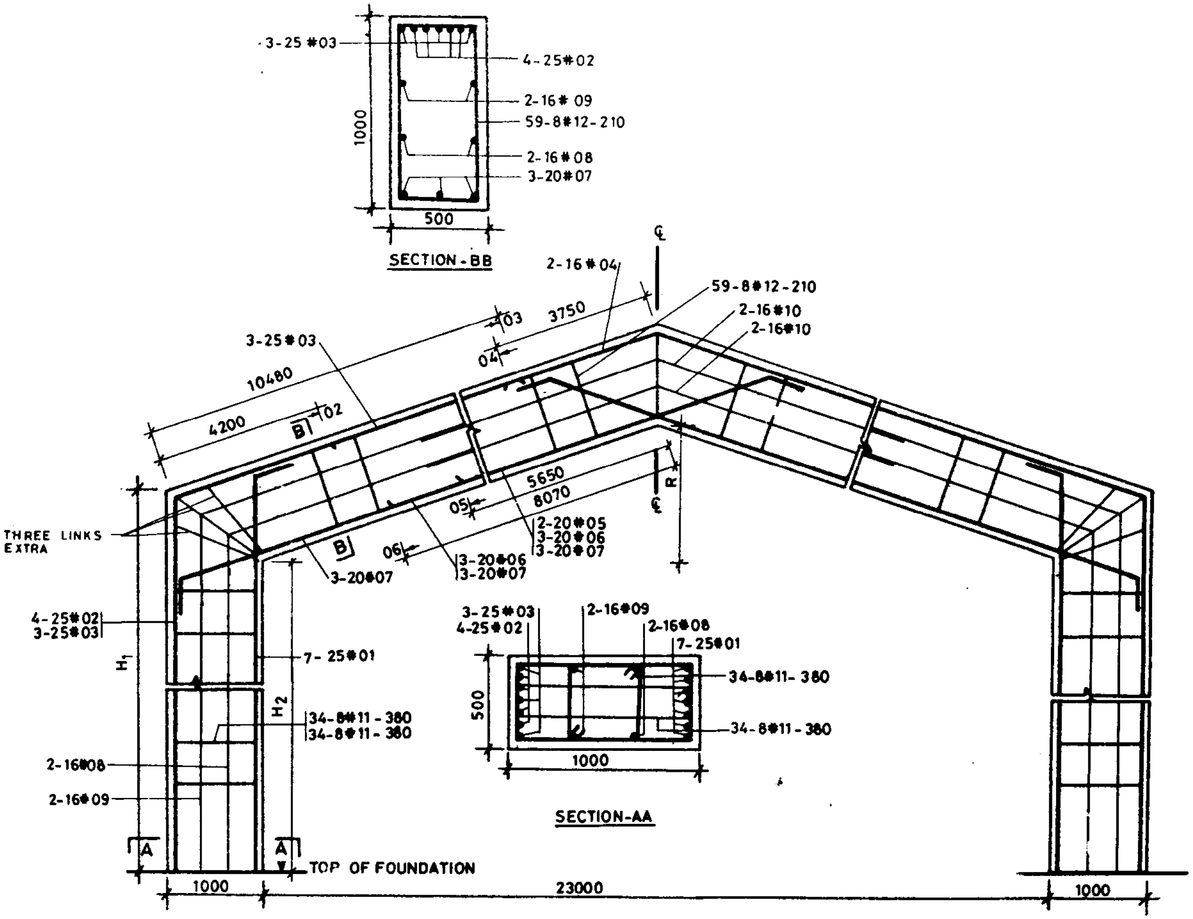
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS PRINCIPAL RAFTER No. OF PURLINS	SPACING
1 in 3	9861	9140	3833	11	1278
1 in 4	9891	9110	2875	10	1387
1 in 5	9910	9090	2300	10	1372

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE: 17
3. DISTANCE OF THE NEAREST PURLIN LUG(℄) FROM THE a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300

DRAWING No. 17 (REFER TABLE 17)

No. OF BAYS : ONE
SPAN : 24.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 9.5 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415



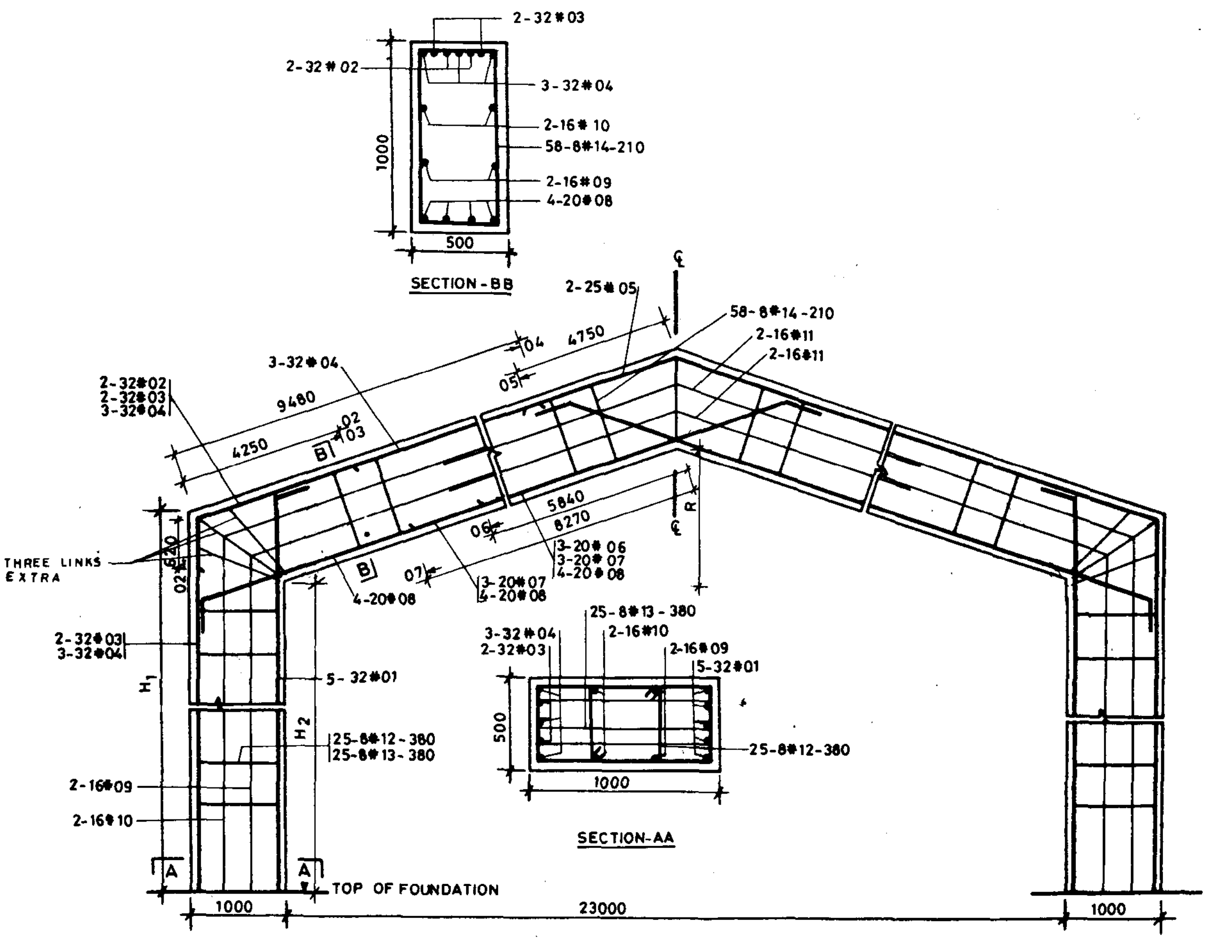
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS	
				PRINCIPAL RAFTER	
				No. OF PURLINS	SPACING
1 in 3	12861	12140	3833	11	1278
1 in 4	12891	12110	2875	10	1387
1 in 5	12910	12090	2300	10	1372

NOTE :

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE: 18
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300

DRAWING No. 18 (REFER TABLE 18)

No. OF BAYS : ONE
SPAN : 24.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 12.5 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415



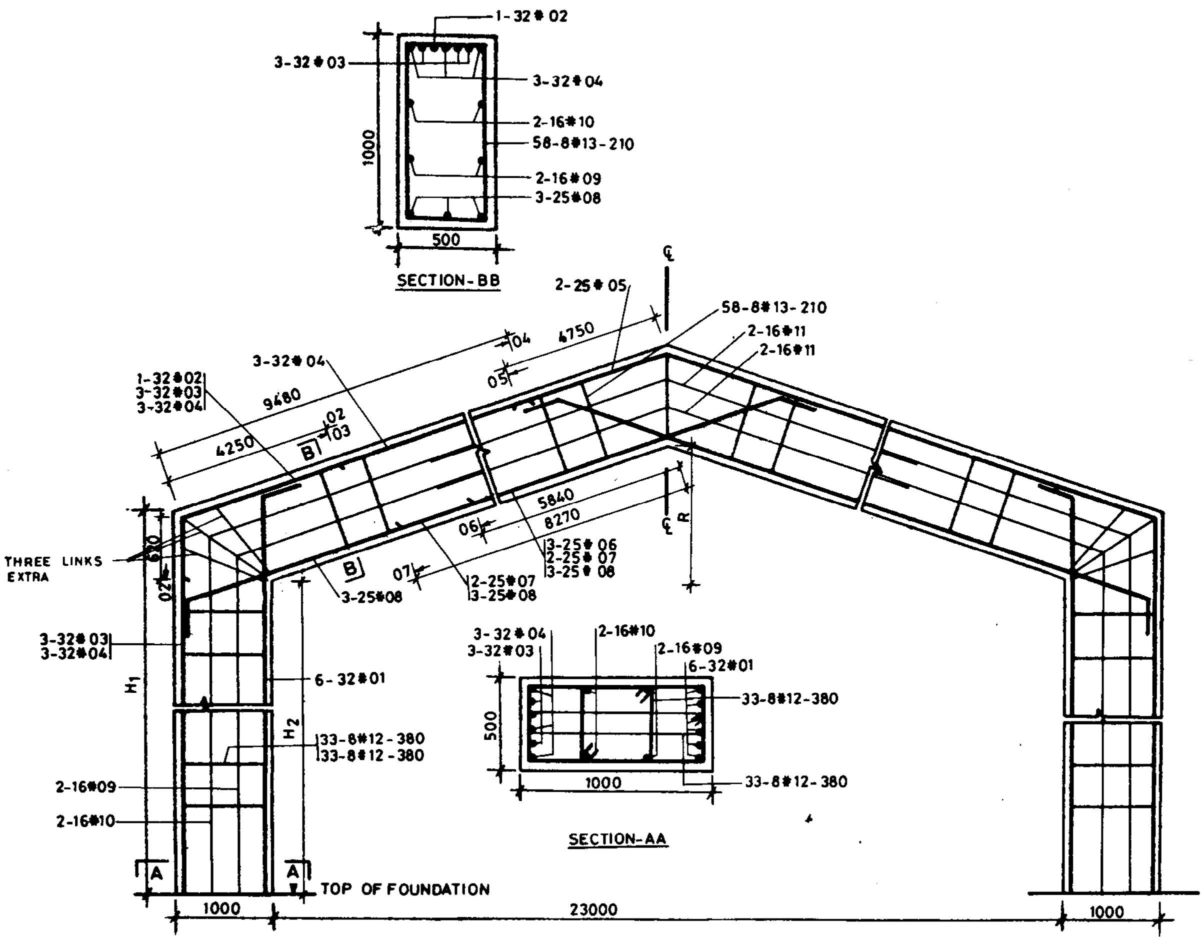
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS	
				PRINCIPAL RAFTER	
				No. OF PURLINS	SPACING
1 in 3	9861	9063	3910	11	1272
1 in 4	9891	9028	2958	10	1380
1 in 5	9910	9004	2386	10	1365

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 19
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360

DRAWING No. 19 (REFER TABLE 19)

No. OF BAYS	: ONE
SPAN	: 24.0 m
SPACING	: 12.0 m
COLUMN HEIGHT	: 9.5 m
SUPPORT CONDITION	: FIXED
FOR ALL WIND AND SEISMIC ZONES	
MATERIALS:	
CONCRETE	: M 25
STEEL	: Fe 415



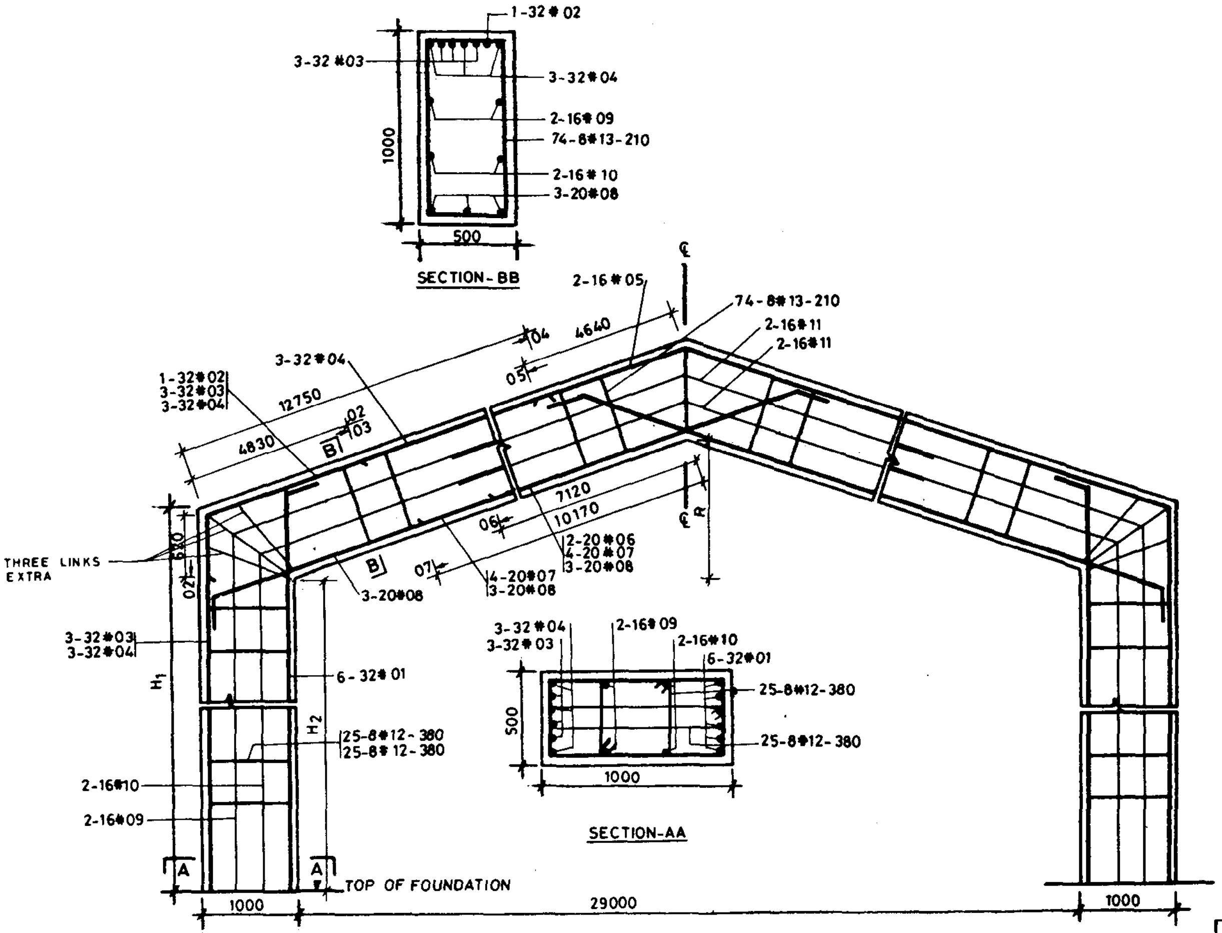
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS PRINCIPAL RAFTER	
				No. OF PURLINS	SPACING
1 in 3	12861	12140	3833	11	1272
1 in 4	12891	12110	2875	10	1380
1 in 5	12910	12090	2300	10	1365

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 20
3. DISTANCE OF THE NEAREST PURLIN LUG(℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360

DRAWING No. 20 (REFER TABLE 20)

No. OF BAYS	: ONE
SPAN	: 24.0m
SPACING	: 12.0m
COLUMN HEIGHT	: 12.5m
SUPPORT CONDITION	: FIXED
FOR ALL WIND AND SEISMIC ZONES	
MATERIALS:	
CONCRETE	: M 25
STEEL	: Fe 415



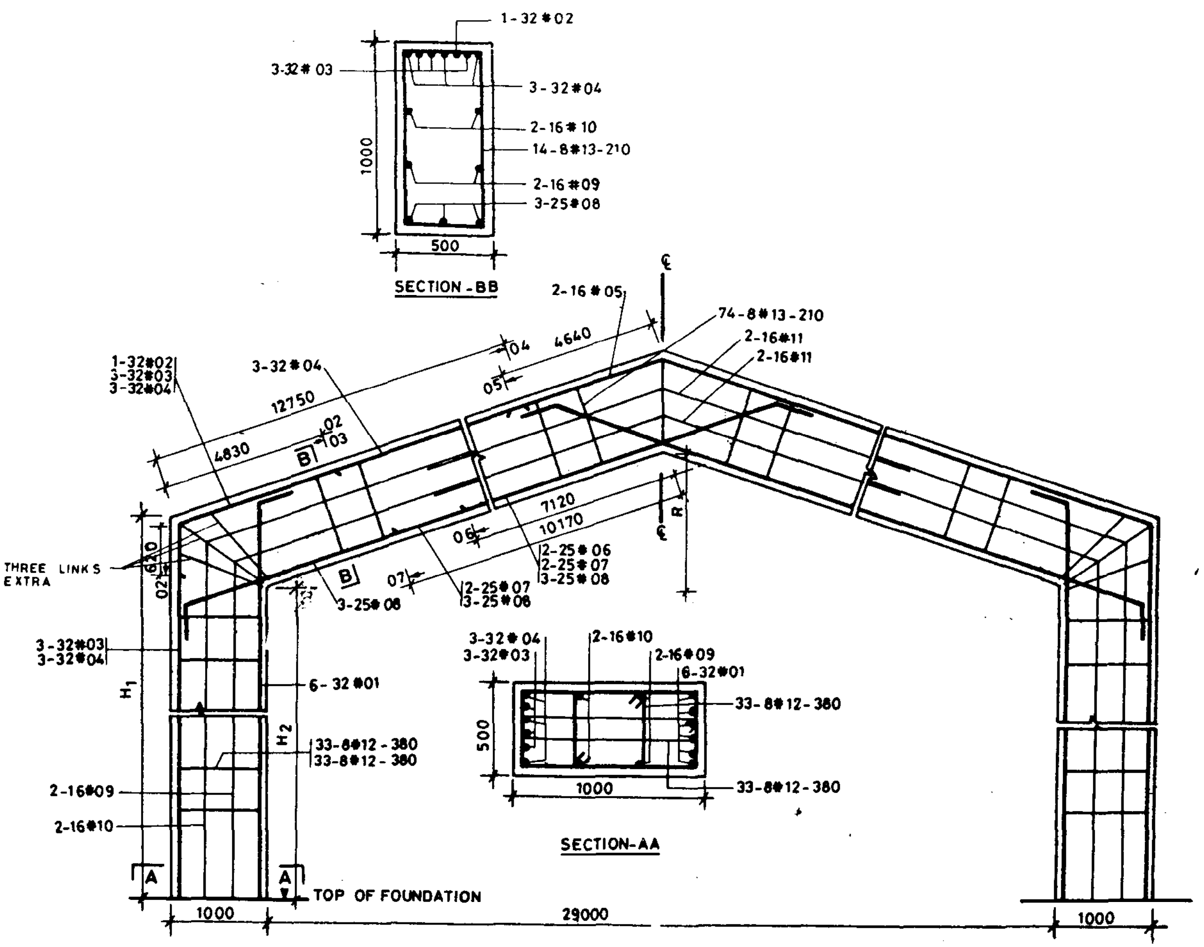
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS	
				PRINCIPAL RAFTER	
				No. OF PURLINS	SPACING
1 in 3	9861	9140	4833	13	1328
1 in 4	9891	9110	3625	13	1298
1 in 5	9910	9090	2900	12	1400

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE: 21
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300

DRAWING No. 21 (REFER TABLE.21)

No.OF BAYS : ONE
SPAN : 30.0m
SPACING : 6.0 m
COLUMN HEIGHT : 9.5 m
SUPPORT CONDITION FOR ALL WIND AND SEISMIC ZONES : FIXED
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415



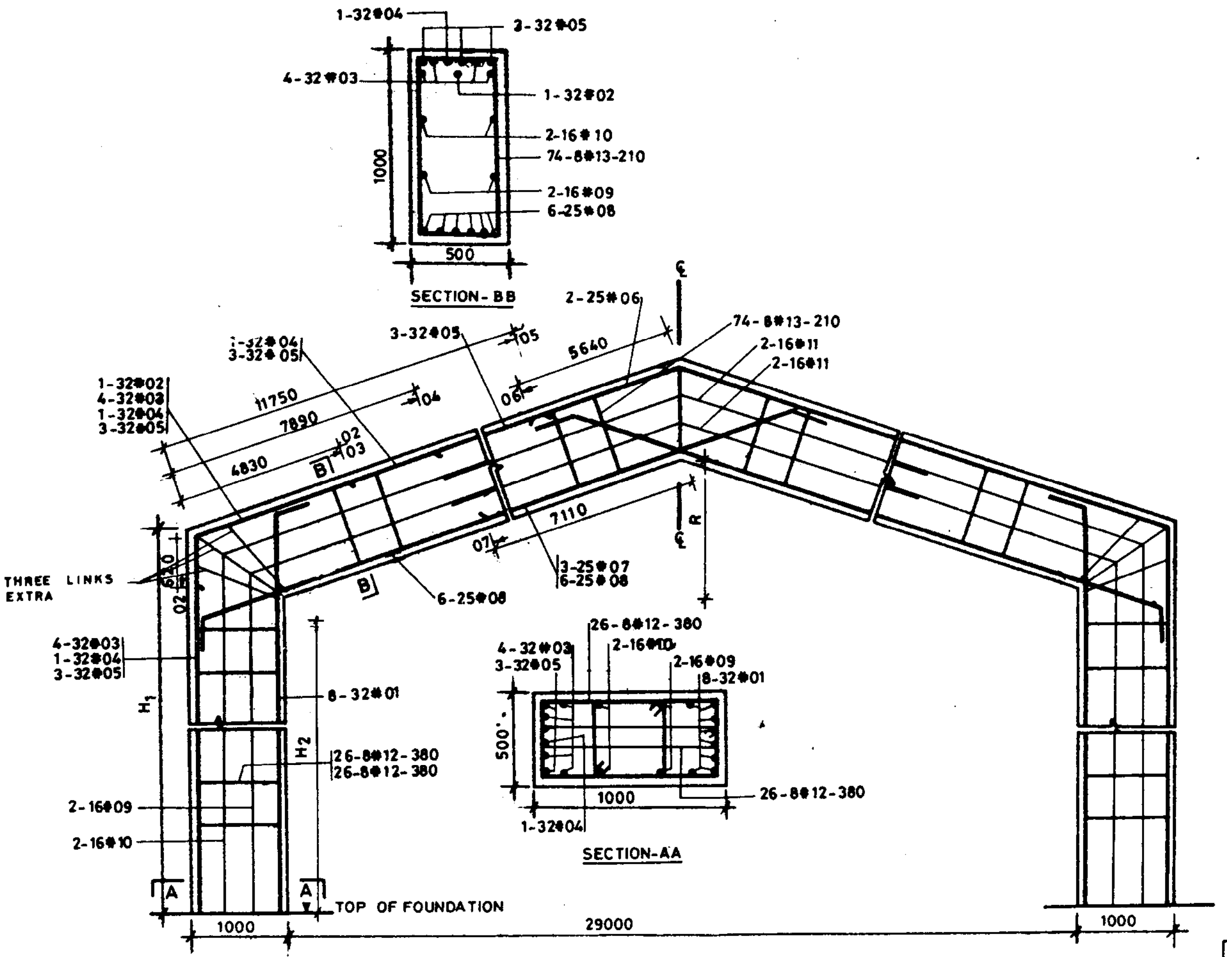
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS PRINCIPAL RAFTER No. OF PURLINS	SPACING
1 in 3	12861	12063	4910	13	1328
1 in 4	12891	12028	3707	13	1298
1 in 5	12910	12004	2986	12	1400

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE: 22
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300

DRAWING No. 22 (REFER TABLE 22)

No. OF BAYS : ONE
SPAN : 30.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 12.5 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415



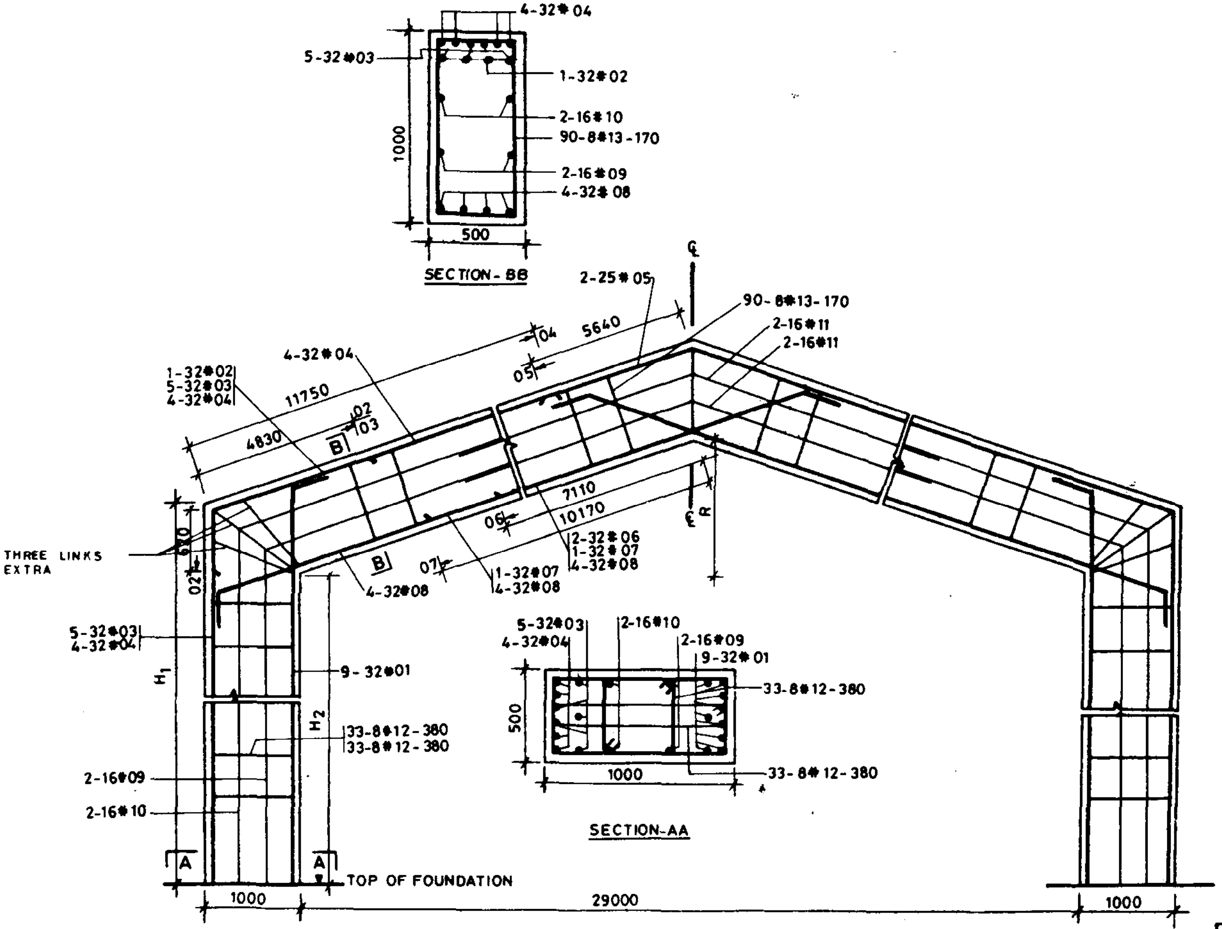
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS	
				PRINCIPAL RAFTER	
				No. OF PURLINS	SPACING
1 in 3	9861	9063	4910	13	1323
1 in 4	9891	9028	3707	13	1293
1 in 5	9910	9004	2986	12	1395

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 23
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360

DRAWING No. 23 (REFER TABLE 23)

No. OF BAYS	: ONE
SPAN	: 30.0 m
SPACING	: 12.0 m
COLUMN HEIGHT	: 9.5 m
SUPPORT CONDITION	: FIXED
FOR ALL WIND AND SEISMIC ZONES	
MATERIALS:	
CONCRETE	: M 25
STEEL	: Fe 415



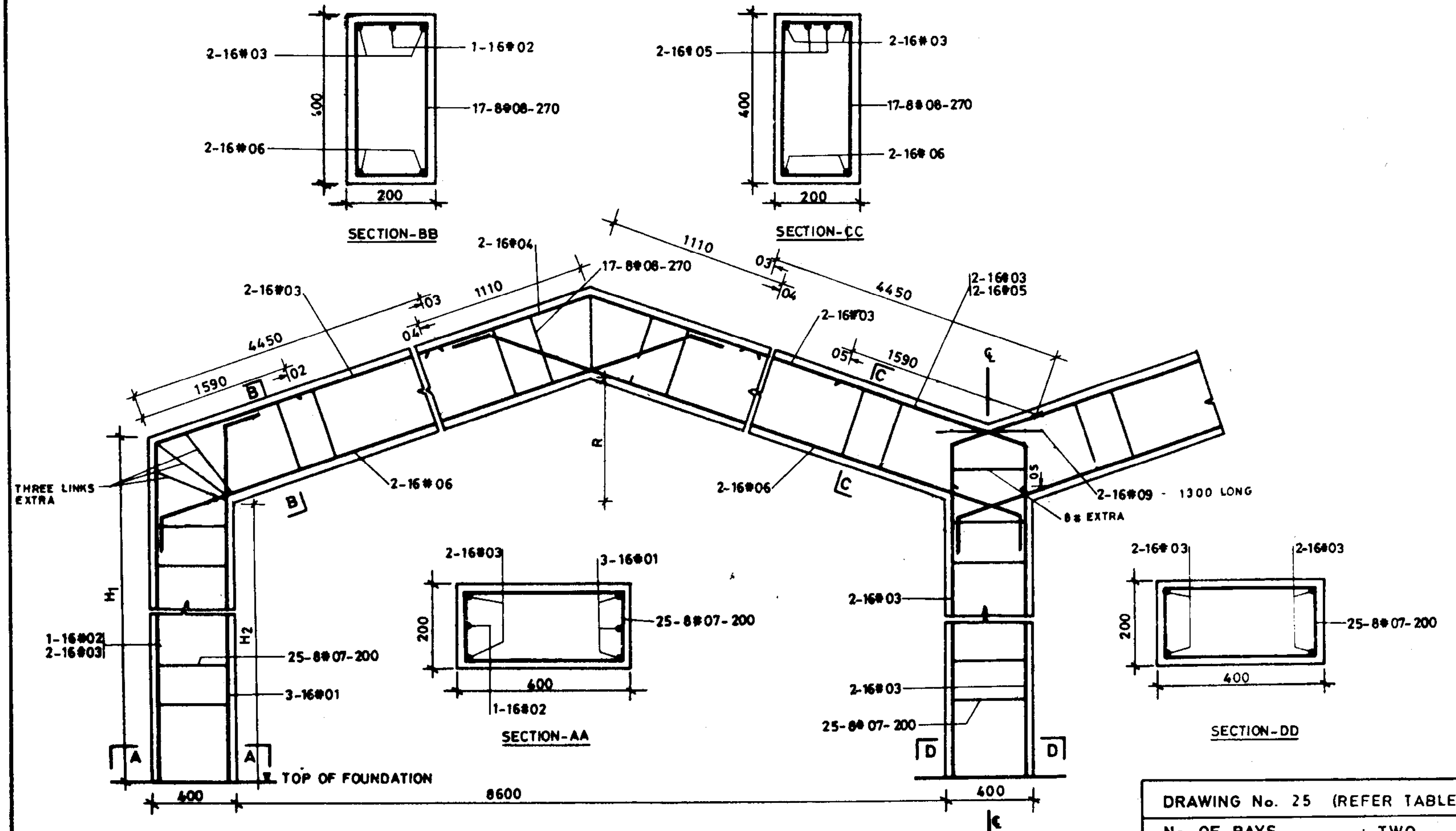
SLOPE	H1	H2	R	No. AND SPACING OF PURLINS PRINCIPAL RAFTER No. OF PURLINS	 SPACING
1 in 3	12861	12140	4833	13	1323
1 in 4	12891	12110	3625	13	1293
1 in 5	12910	12090	2900	12	1395

NOTE:

1. ALL DIMENSIONS ARE IN *mm*
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE: 24
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE: 100
   b. RIDGE : 360

DRAWING No. 24 (REFER TABLE 24)

No. OF BAYS	: ONE
SPAN	: 30.0m
SPACING	: 12.0m
COLUMN HEIGHT	: 12.5m
SUPPORT CONDITION	: FIXED
FOR ALL WIND AND SEISMIC ZONES	
MATERIALS:	
CONCRETE	: M 25
STEEL	: Fe 415



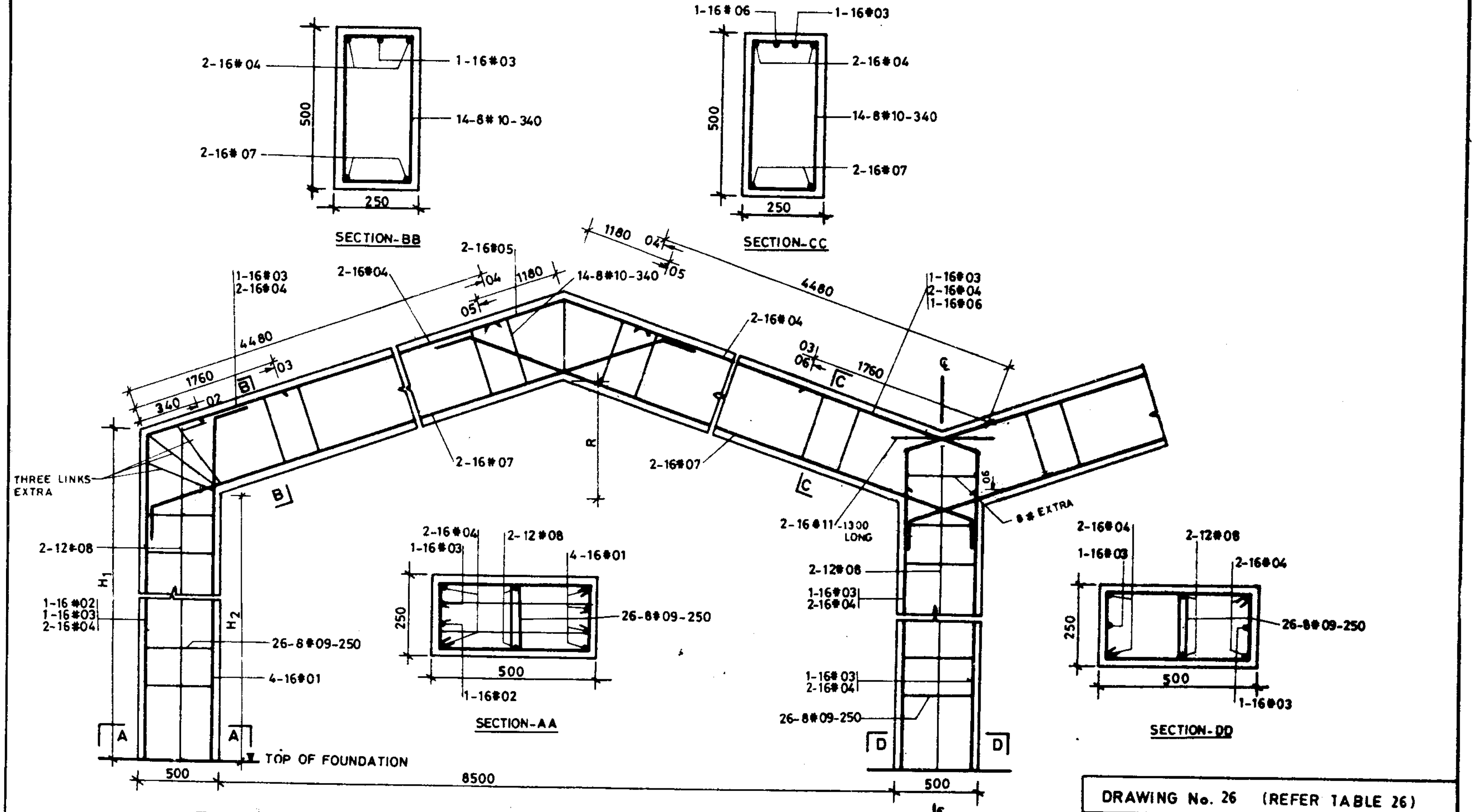
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	5144	4856	1433	5	1139	4	1381
1 in 4	5156	4844	1075	5	1111	4	1346
1 in 5	5164	4836	860	5	1098	4	1330

NOTE :

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 25
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300
   c. VALLEY : 300

DRAWING No. 25 (REFER TABLE 25)

No. OF BAYS : TWO
SPAN : 9.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 5.0 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415



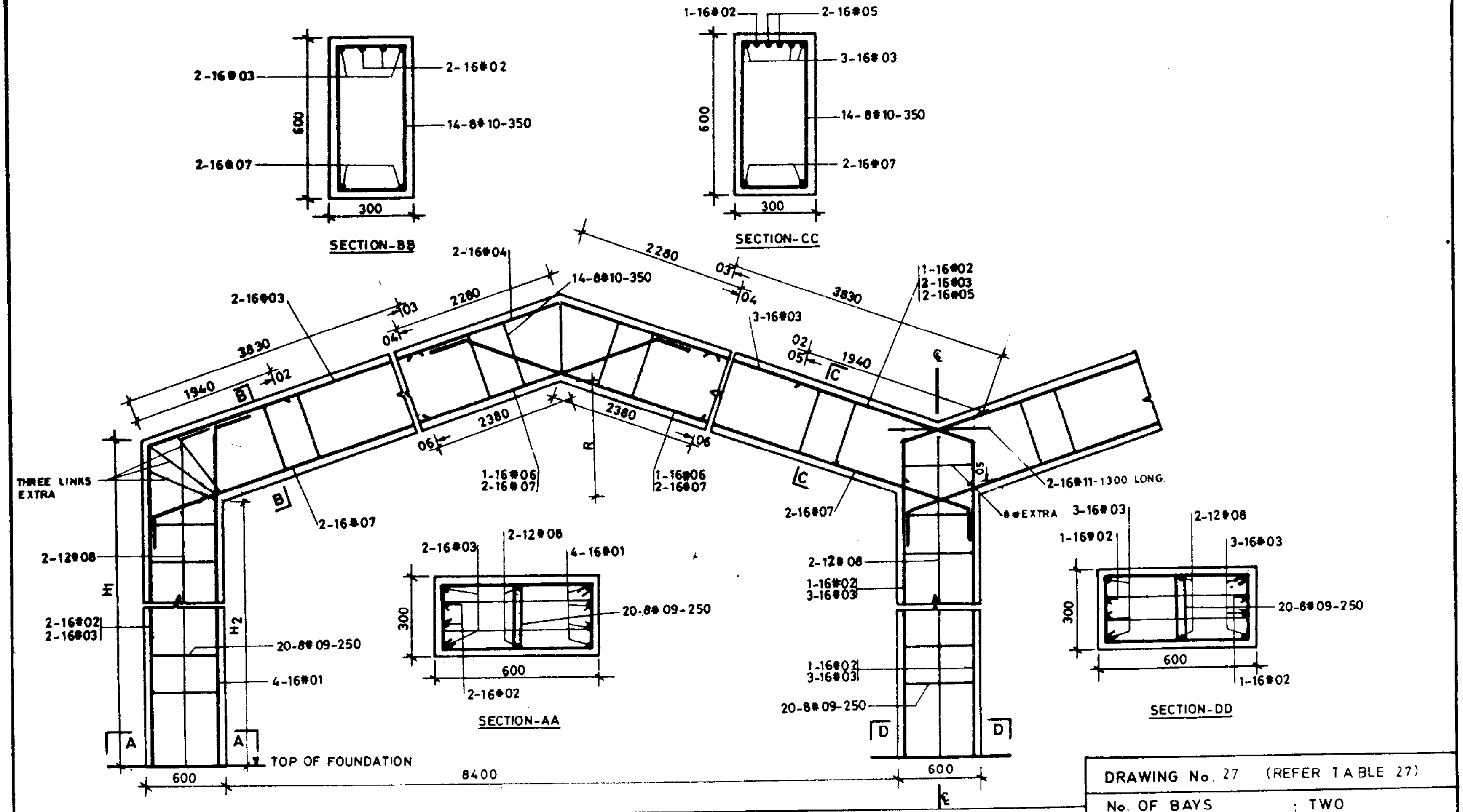
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	6680	6320	1417	5	1151	4	1381
1 in 4	6695	6305	1063	5	1124	4	1346
1 in 5	6705	6295	850	5	1111	4	1330

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 26
3. DISTANCE OF THE NEAREST PURLIN LUG (Ꞓ) FROM THE a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300
   c. VALLEY : 300

DRAWING No. 26 (REFER TABLE 26)

No. OF BAYS : TWO
SPAN : 9.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 6.5 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415



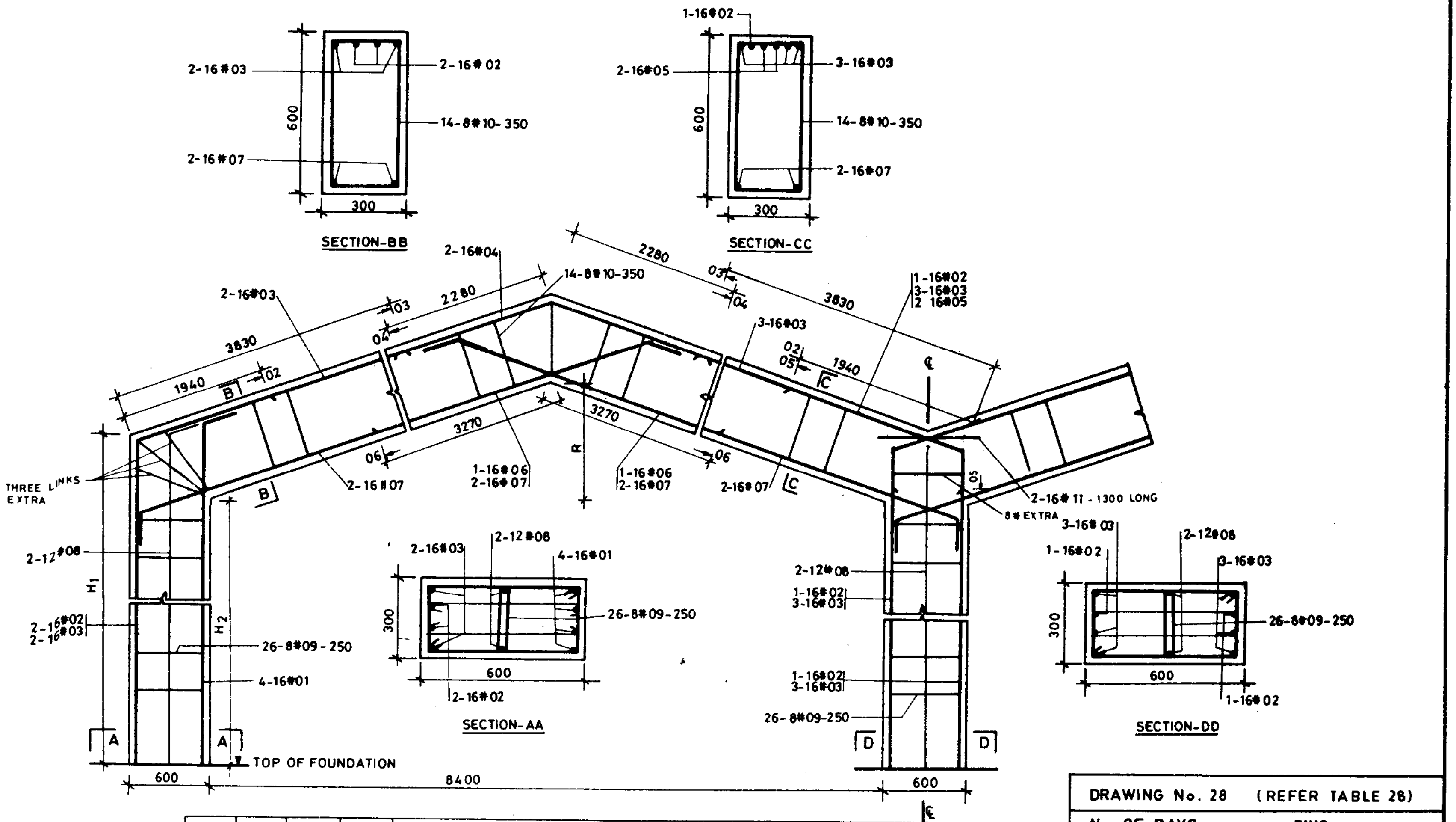
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	5217	4784	1400	5	1150	4	1361
1 in 4	5234	4766	1050	5	1122	4	1326
1 in 5	5246	4754	840	5	1109	4	1310

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 27
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360
   c. VALLEY : 300

DRAWING No. 27 (REFER TABLE 27)

No. OF BAYS	:	TWO
SPAN	:	9.0 m
SPACING	:	12.0 m
COLUMN HEIGHT	:	5.0 m
SUPPORT CONDITION	:	FIXED
FOR ALL WIND AND SEISMIC ZONES		
MATERIALS:		
CONCRETE	:	M 25
STEEL	:	Fe 415



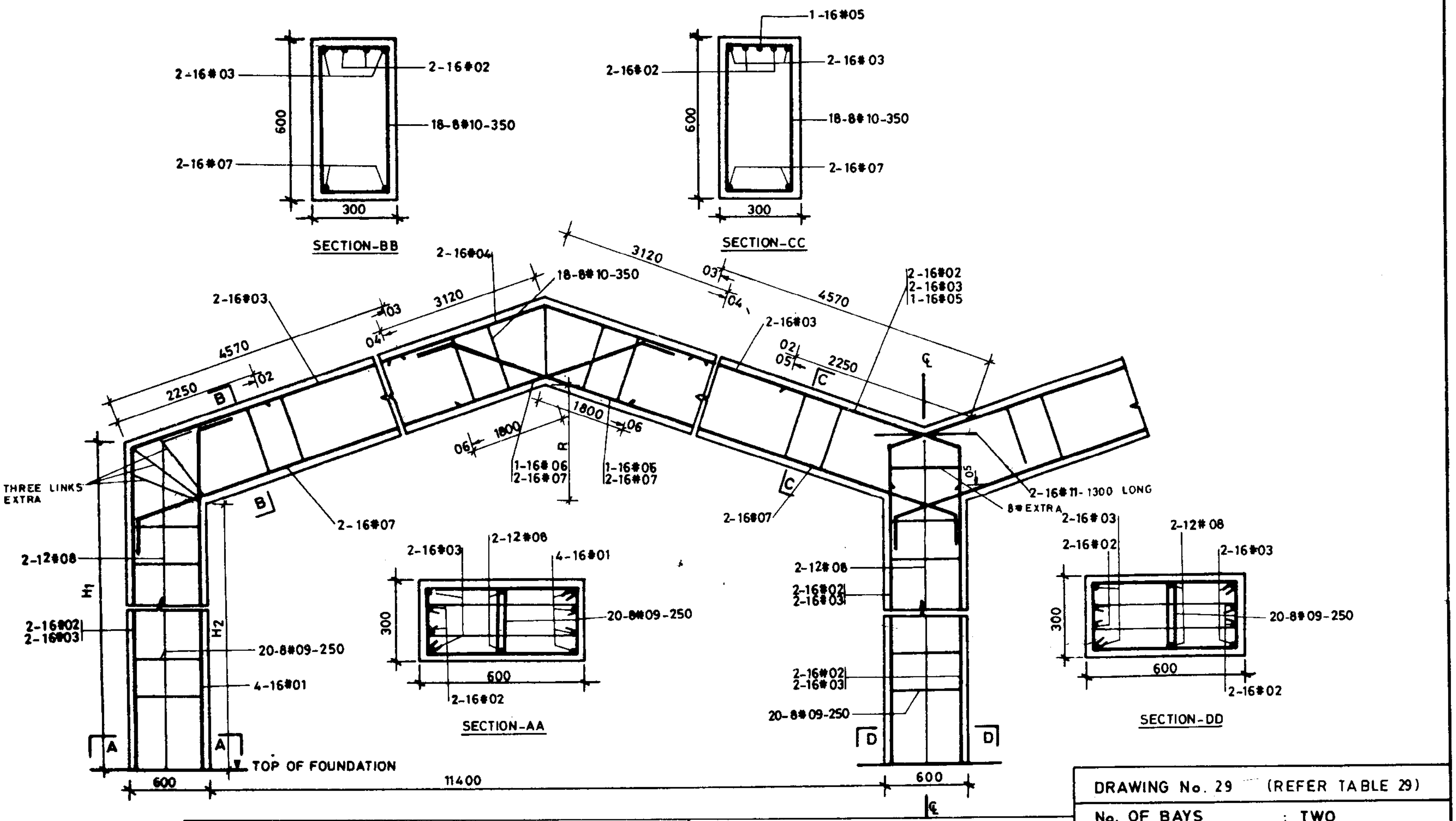
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	6717	6284	1400	5	1150	4	1361
1 in 5	6734	6256	1050	5	1122	4	1326
1 in 5	6746	6254	840	5	1109	4	1310

NOTE :

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 28
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360
   c. VALLEY : 300

DRAWING No. 28 (REFER TABLE 28)

No. OF BAYS : TWO
SPAN : 9.0 m
SPACING : 12.0 m
COLUMN HEIGHT : 6.5 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415



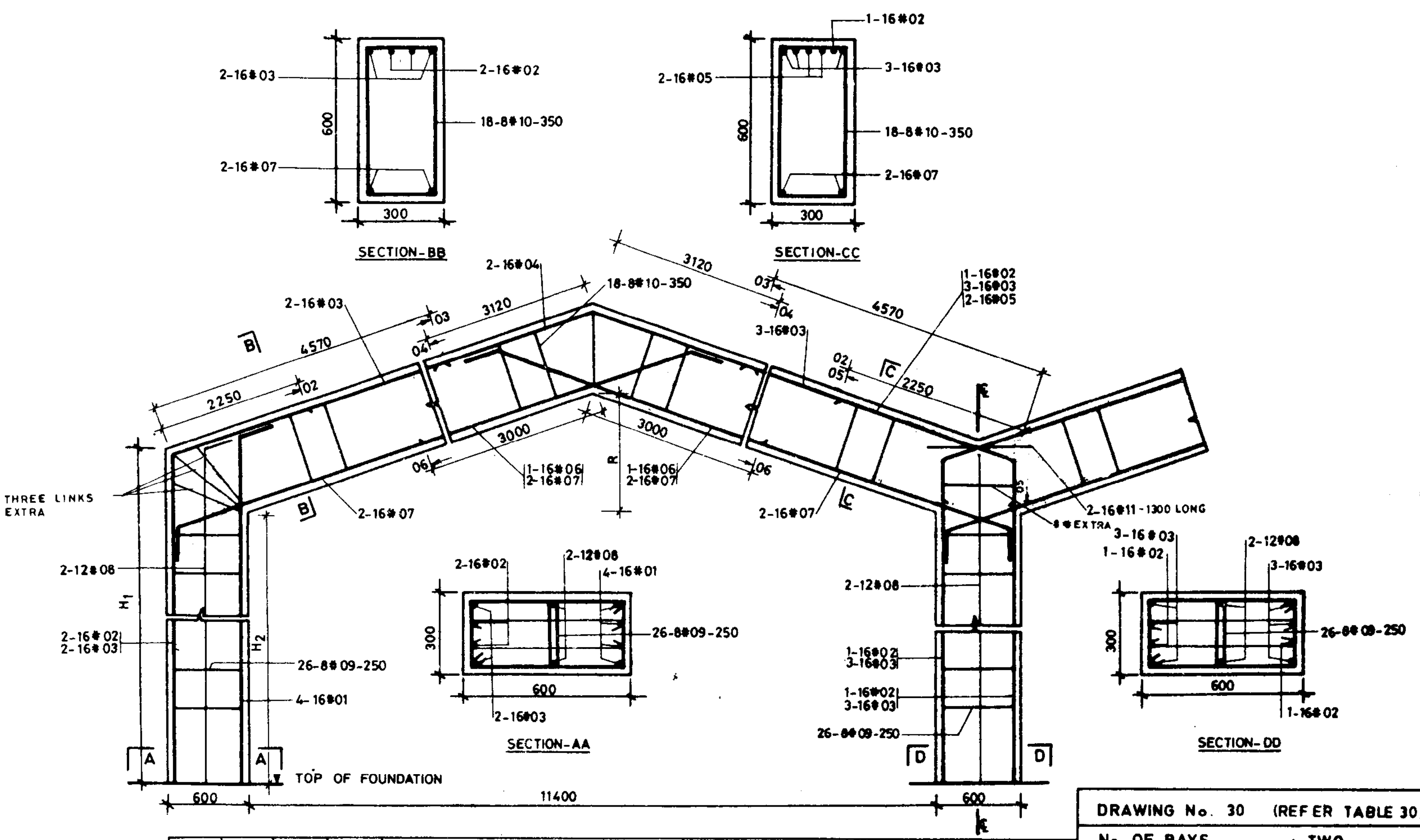
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	5217	4784	1900	6	1248	6	1145
1 in 4	5234	4766	1425	6	1219	5	1396
1 in 5	5246	4754	1140	6	1205	5	1380

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 29
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300
   c. VALLEY : 300

DRAWING No. 29 (REFER TABLE 29)

No. OF BAYS : TWO
SPAN : 12.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 5.0 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415



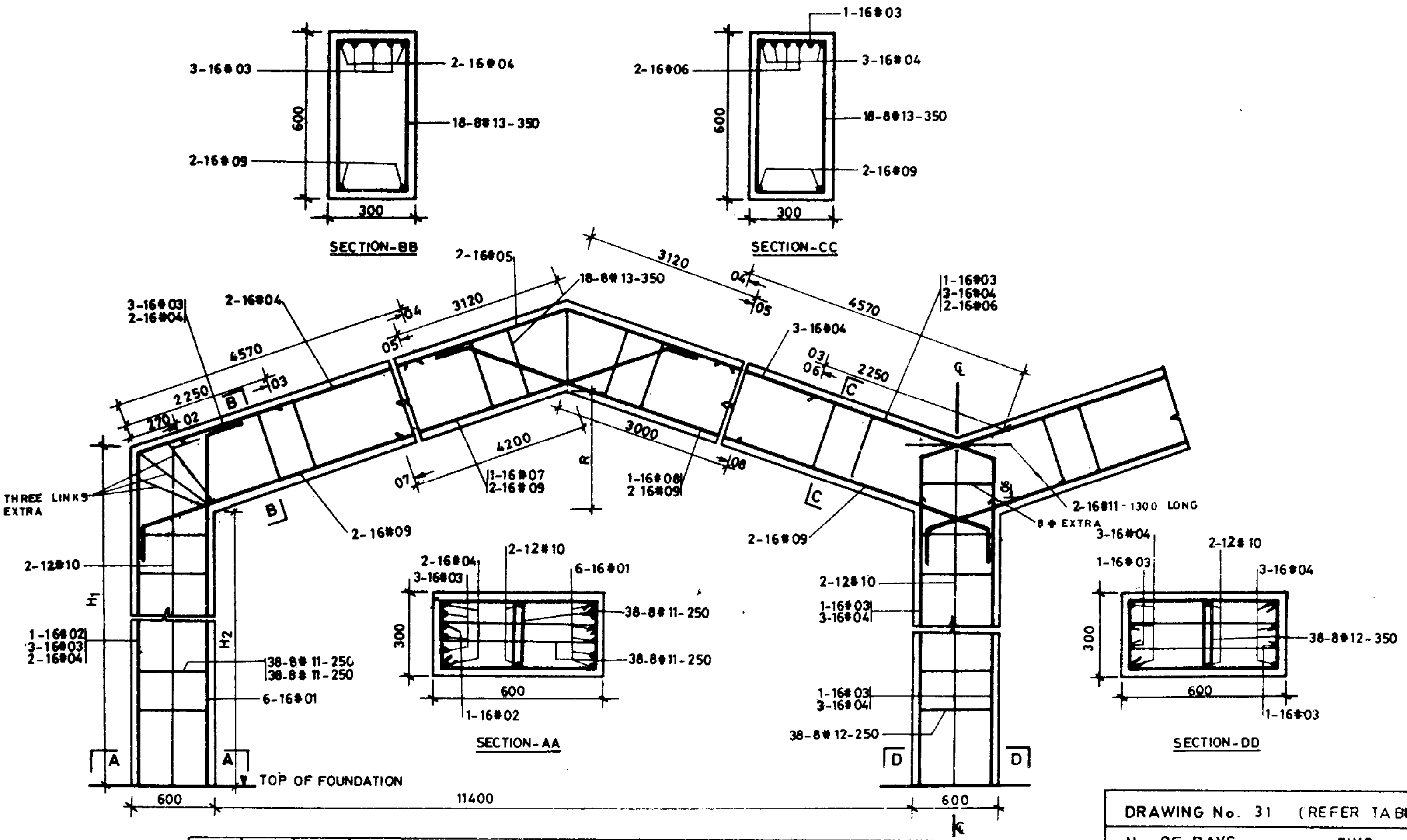
SLOPE	H1	H2	R	No. AND SPACING OF PURLINS: EXTERIOR RAFTER: No OF PURLINS	EXTERIOR RAFTER: SPACING	INTERIOR RAFTER: No OF PURLINS	INTERIOR RAFTER: SPACING
1 in 3	6717	6284	1900	6	1248	6	1145
1 in 4	6734	6266	1425	6	1219	5	1396
1 in 5	6746	6254	1140	6	1205	5	1380

NOTE :

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 30
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300
   c. VALLEY : 300

DRAWING No. 30 (REFER TABLE 30)

No. OF BAYS : TWO
SPAN : 12.0m
SPACING : 6.0 m
COLUMN HEIGHT : 6.5m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415



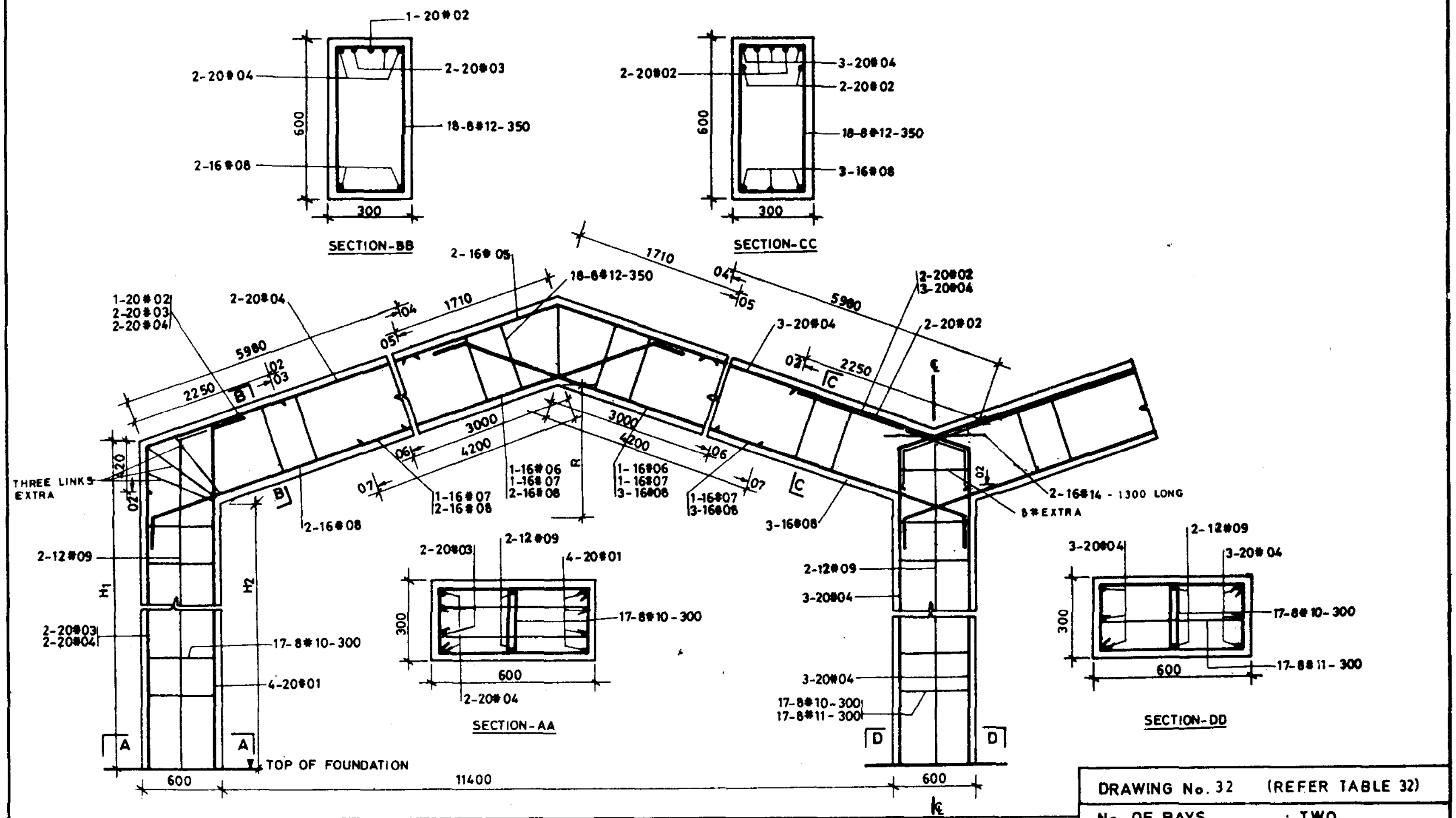
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No OF PURLINS	SPACING
1in 3	9717	9284	1900	6	1248	6	1145
1in4	9734	9266	1425	6	12 19	5	1396
1in5	9746	9154	1140	6	1205	5	1380

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE: 31
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300
   c. VALLEY : 300

DRAWING No. 31 (REFER TABLE 31)

No. OF BAYS	: TWO
SPAN	: 12.0 m
SPACING	: 6.0 m
COLUMN HEIGHT	: 9.5 m
SUPPORT CONDITION	: FIXED
FOR ALL WIND AND SEISMIC ZONES	
MATERIALS:	
CONCRETE	: M 25
STEEL	: Fe 415



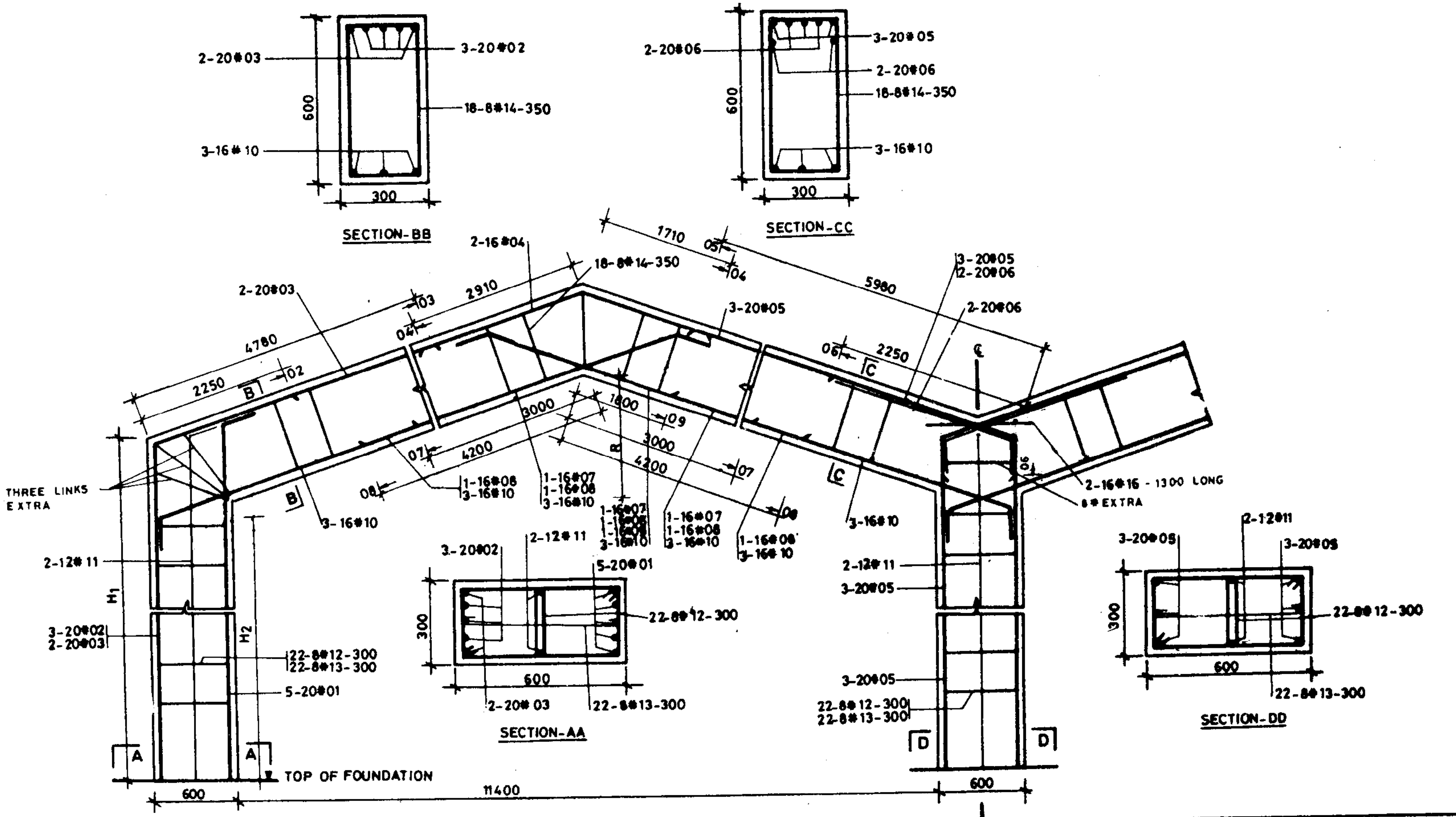
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLIN			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	5217	4707	1977	6	1236	6	1133
1 in 4	5234	4684	1507	6	1207	5	1381
1 in 5	5246	4668	1226	6	1193	5	1365

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 32
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   - a. EXTERNAL COLUMN FACE : 100
   - b. RIDGE : 360
   - c. VALLEY : 300

DRAWING No. 32 (REFER TABLE 32)

No. OF BAYS	: TWO
SPAN	: 12.0 m
SPACING	: 12.0 m
COLUMN HEIGHT	: 5.0 m
SUPPORT CONDITION	: FIXED
FOR ALL WIND AND SEISMIC ZONES	
MATERIALS:	
CONCRETE	: M 25
STEEL	: Fe 415



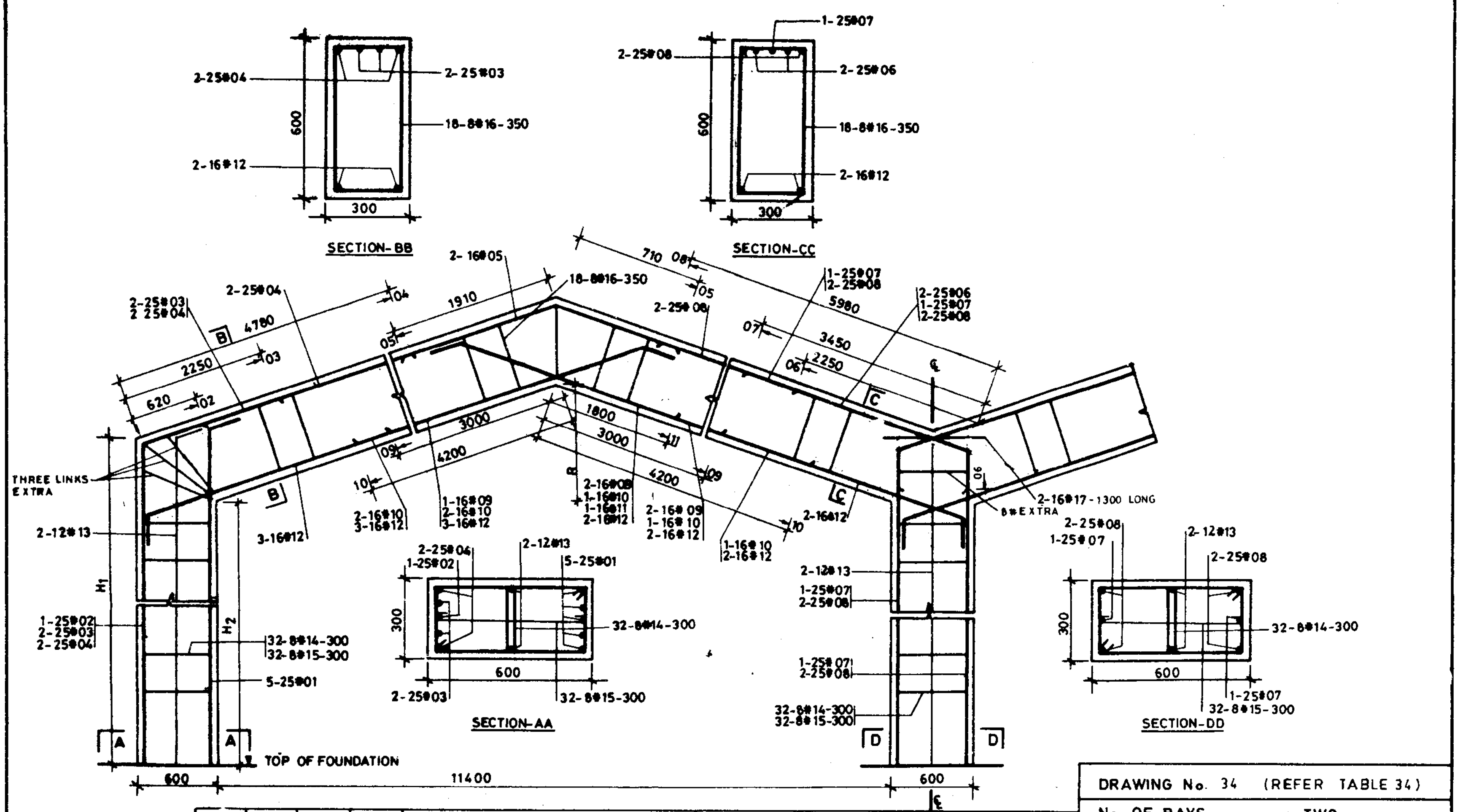
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1in3	6717	6207	1977	6	1236	6	1133
1in4	6734	6184	1507	6	1207	5	1381
1in5	6746	6168	1226	6	1193	5	1365

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANAYSIS TABLE : 33
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360
   c. VALLEY : 300

DRAWING No. 33 (REFER TABLE 33)

No. OF BAYS : TWO
SPAN : 12.0m
SPACING : 12.0m
COLUMN HEIGHT : 6.5m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415



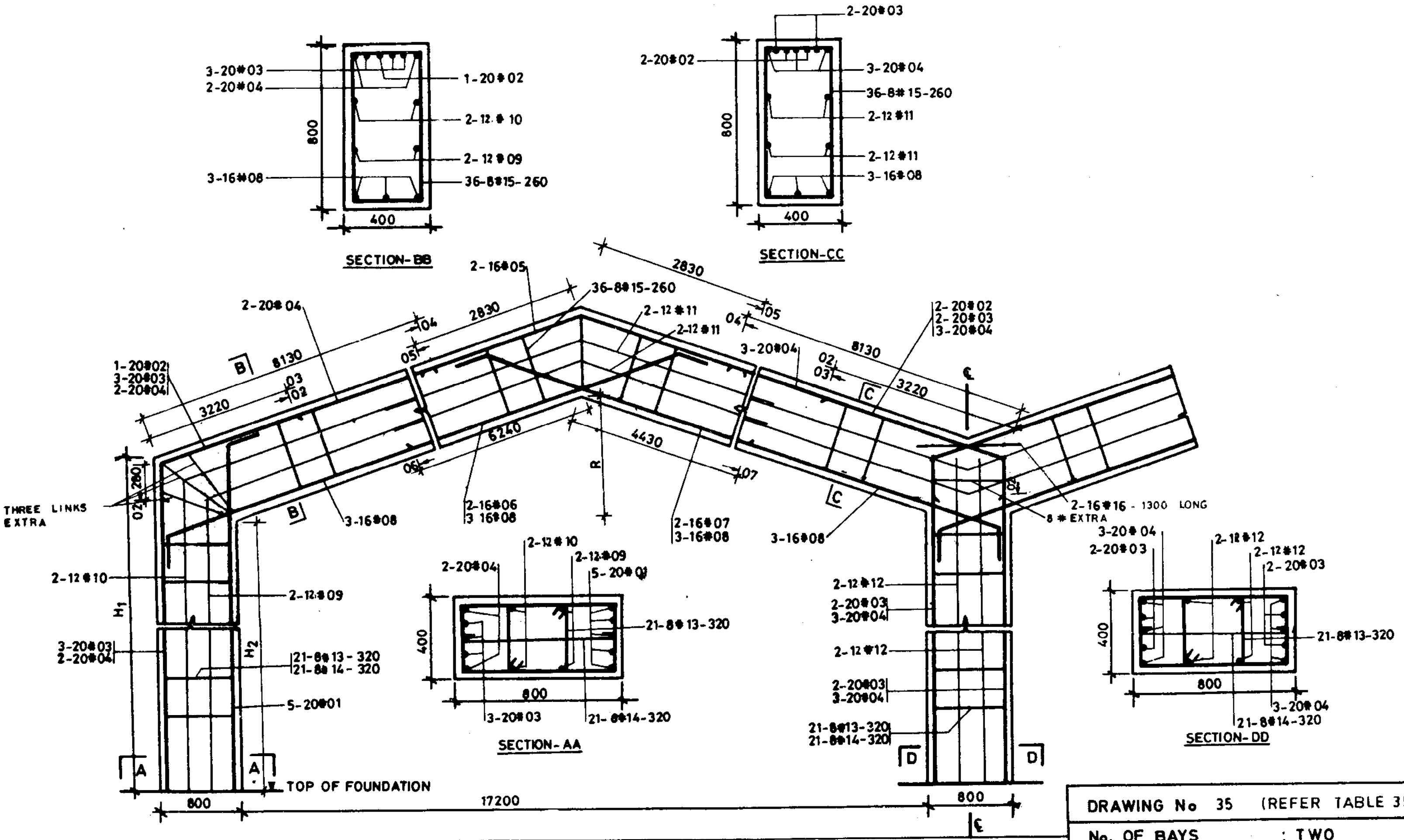
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1in3	9717	9284	1900	6	1236	6	1133
1in4	9734	9266	1425	6	1207	5	1381
1in5	9746	9254	1140	6	1193	5	1365

NOTE :

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANAYSIS TABLE : 34
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   - a. EXTERNAL COLUMN FACE : 100
   - b. RIDGE : 360
   - c. VALLEY : 300

DRAWING No. 34 (REFER TABLE 34)

No. OF BAYS	: TWO
SPAN	: 12.0 m
SPACING	: 12.0 m
COLUMN HEIGHT	: 9.5 m
SUPPORT CONDITION	: FIXED
FOR ALL WIND AND SEISMIC ZONES	
MATERIALS:	
CONCRETE	: M 25
STEEL	: Fe 415



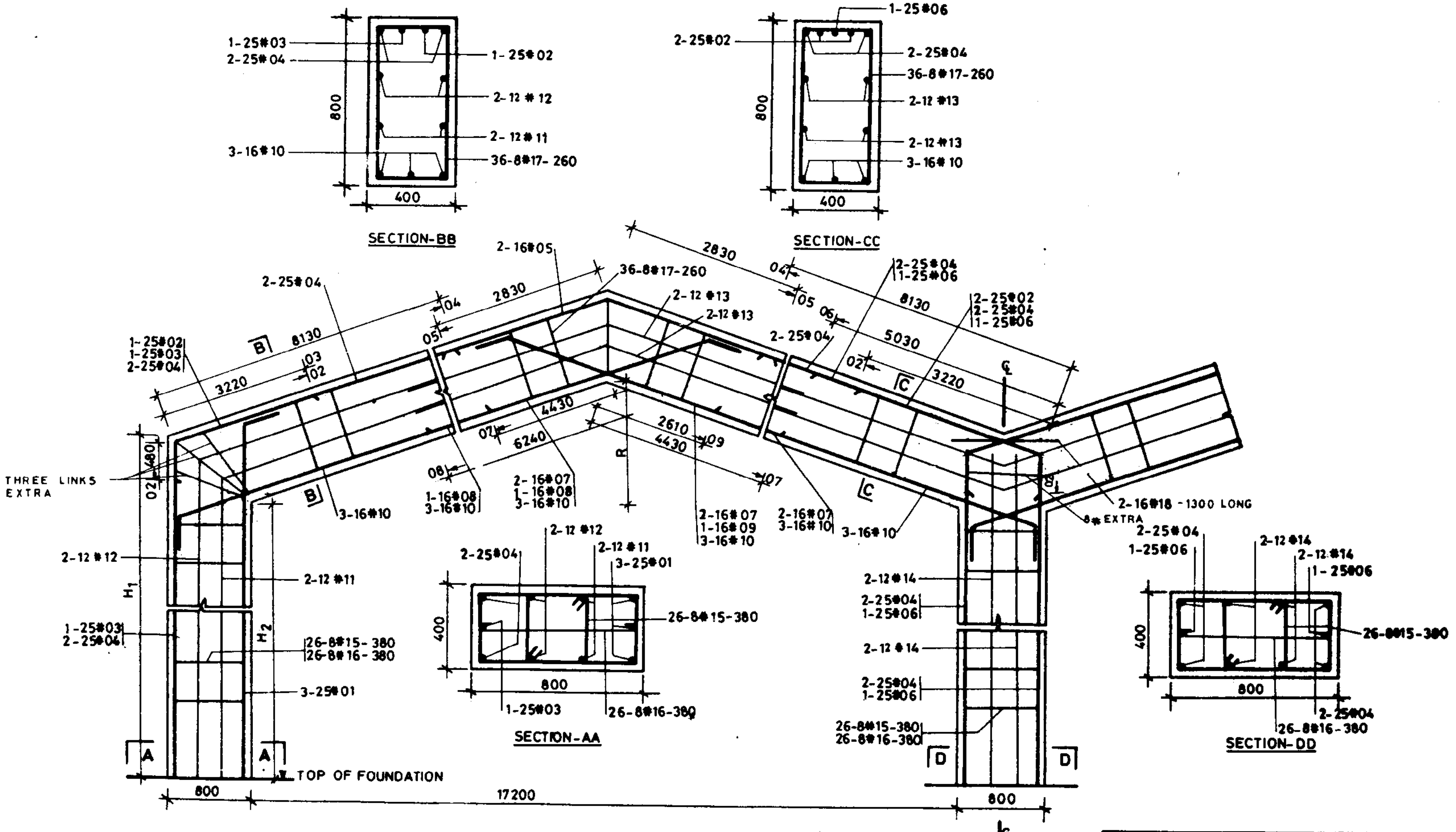
SLOPE	H1	H2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	6789	6212	2867	8	1358	8	1270
1 in 4	6813	6188	2150	8	1327	8	1240
1 in 5	6828	6172	1720	8	1312	8	1225

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE: 35
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   - a. EXTERNAL COLUMN FACE : 100
   - b. RIDGE : 300
   - c. VALLEY : 300

DRAWING No 35 (REFER TABLE 35)

No. OF BAYS : TWO
SPAN : 18.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 6.5 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415

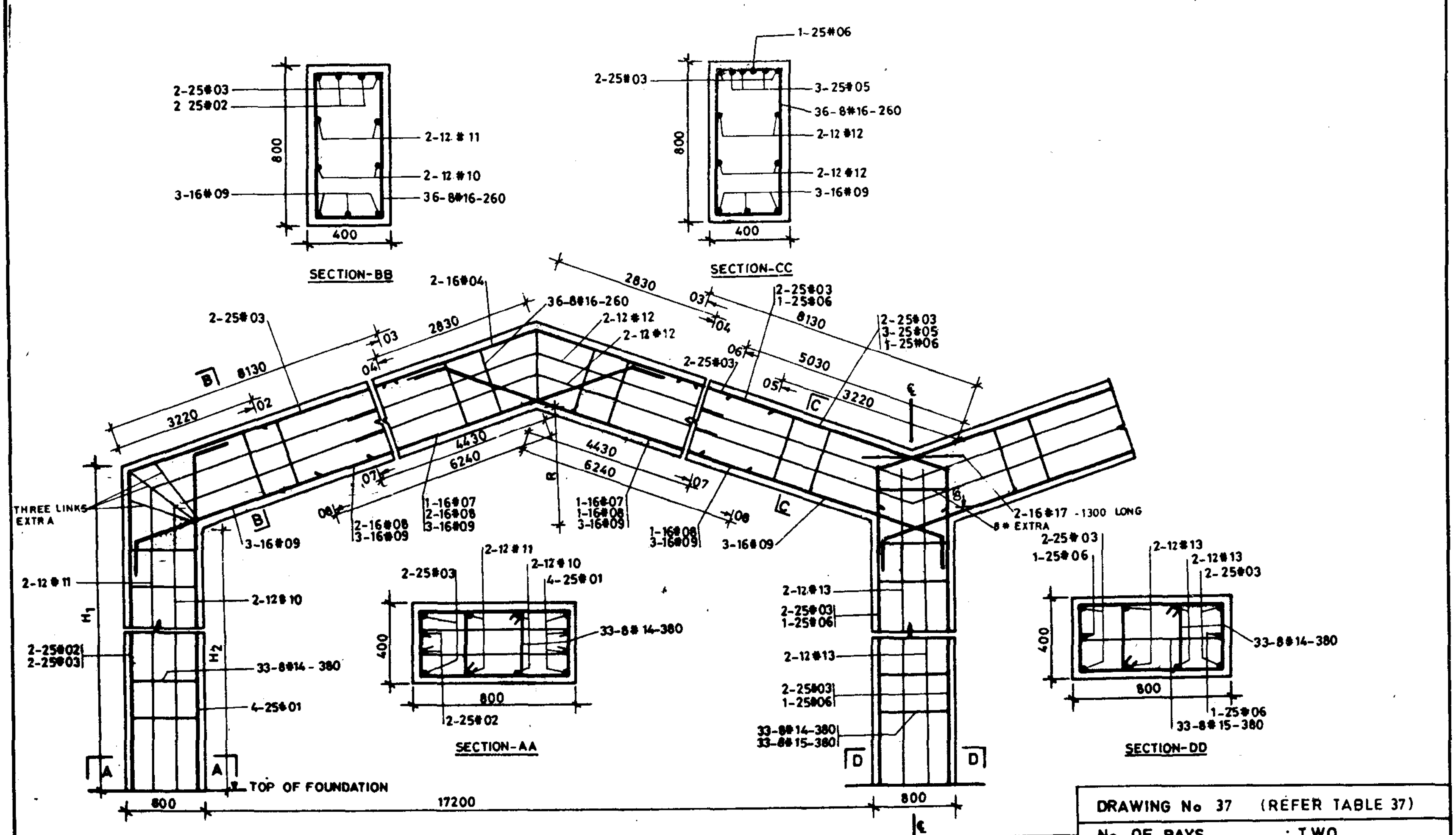


SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No OF PURLINS	SPACING	No OF PURLINS	SPACING
1 in 3	9789	9212	2867	8	1358	8	1270
1 in 4	9813	9188	2150	8	1327	8	1240
1 in 5	9828	9172	1720	8	1312	8	1225

NOTE:
1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 36
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300
   c. VALLEY : 300

DRAWING No 36 (REFER TABLE 36)

No. OF BAYS : TWO
SPAN : 18.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 9.5 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415



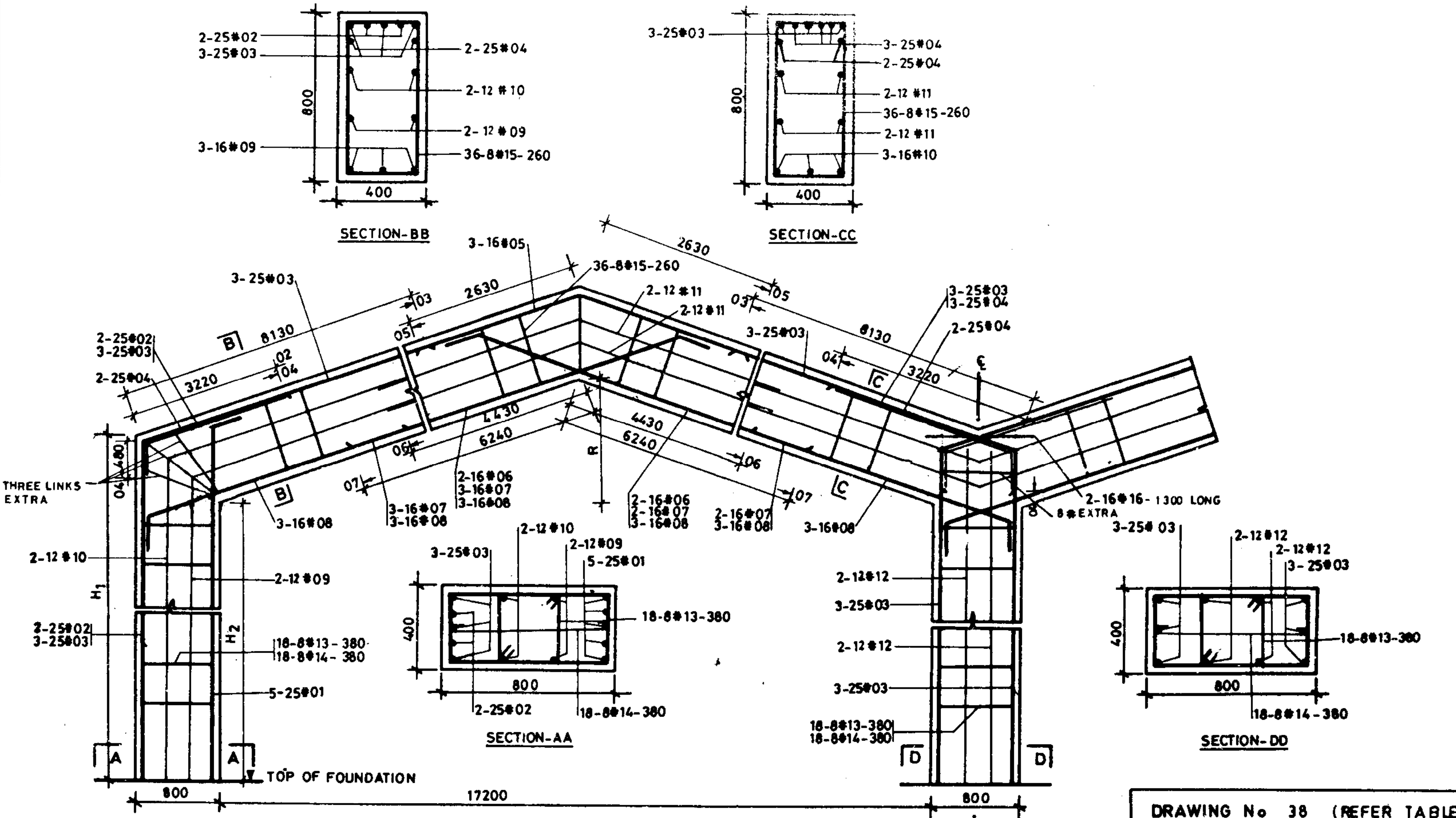
<table>
<tr><th rowspan="3">SLOPE</th><th rowspan="3">H_1</th><th rowspan="3">H_2</th><th rowspan="3">R</th><th colspan="4">No. AND SPACING OF PURLINS</th></tr>
<tr><th colspan="2">EXTERIOR RAFTER</th><th colspan="2">INTERIOR RAFTER</th></tr>
<tr><th>No. OF PURLINS</th><th>SPACING</th><th>No. OF PURLINS</th><th>SPACING</th></tr>
<tr><td>1 in 3</td><td>12789</td><td>12212</td><td>2867</td><td>8</td><td>1358</td><td>8</td><td>1270</td></tr>
<tr><td>1 in 4</td><td>12813</td><td>12188</td><td>2150</td><td>8</td><td>1327</td><td>8</td><td>1240</td></tr>
<tr><td>1 in 5</td><td>12828</td><td>12172</td><td>1720</td><td>8</td><td>1312</td><td>8</td><td>1225</td></tr>
</table>

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE: 37
3. *DISTANCE OF THE NEAREST PURLIN LUG (℄)* FROM THE a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300
   c. VALLEY : 300

DRAWING No 37 (REFER TABLE 37)

No. OF BAYS : TWO
SPAN : 18.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 12.5 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415



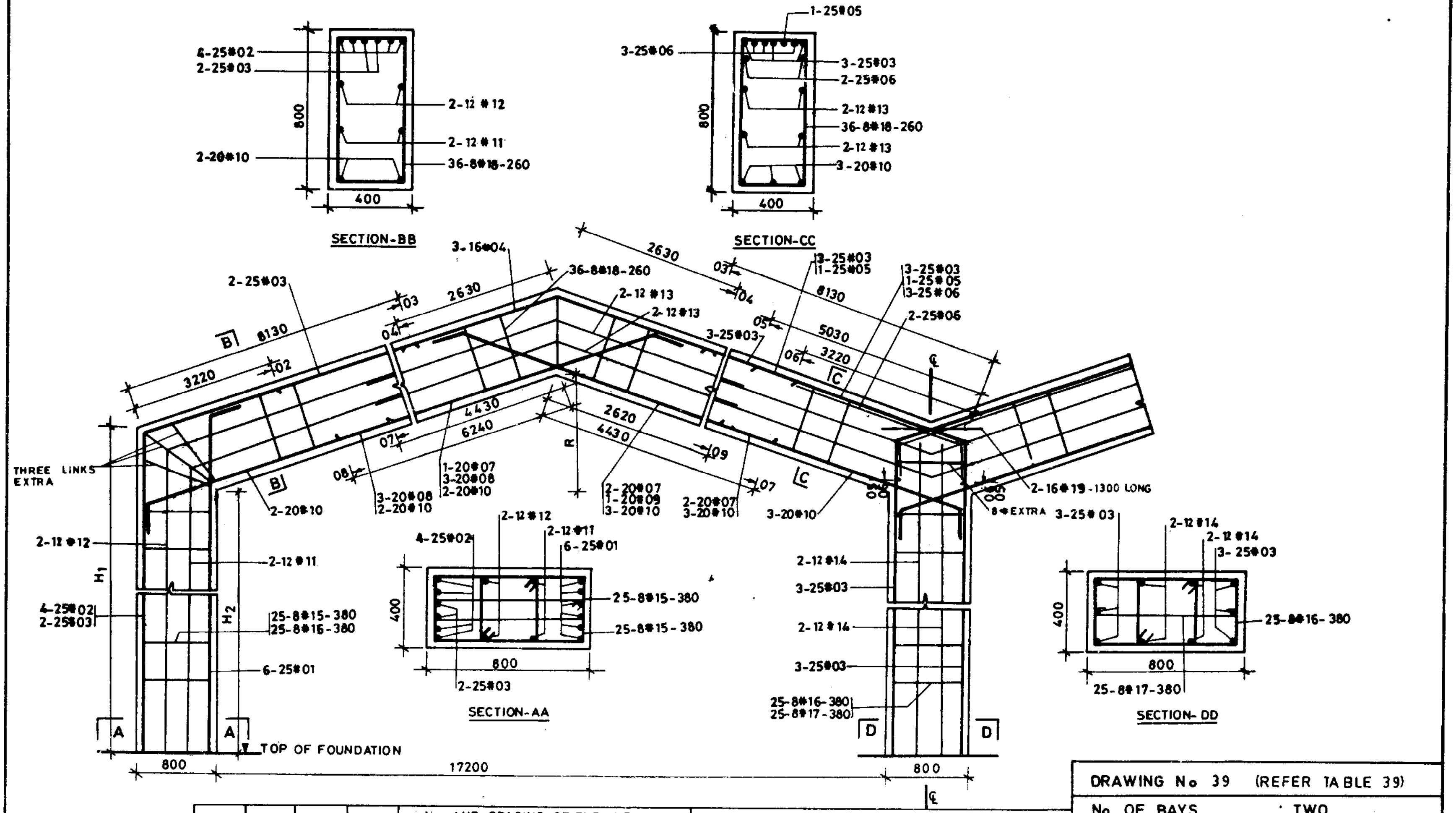
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1in3	6789	6212	2867	8	1350	8	1286
1in4	6813	6188	2150	8	1319	8	1254
1in5	6828	6172	1720	8	1304	8	1239

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 38
3. DISTANCE OF THE NEAREST PURLIN LUG. (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360
   c. VALLEY : 550

DRAWING No 38 (REFER TABLE 38)

No. OF BAYS : TWO
SPAN : 18.0 m
SPACING : 12.0 m
COLUMN HEIGHT : 6.5 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415



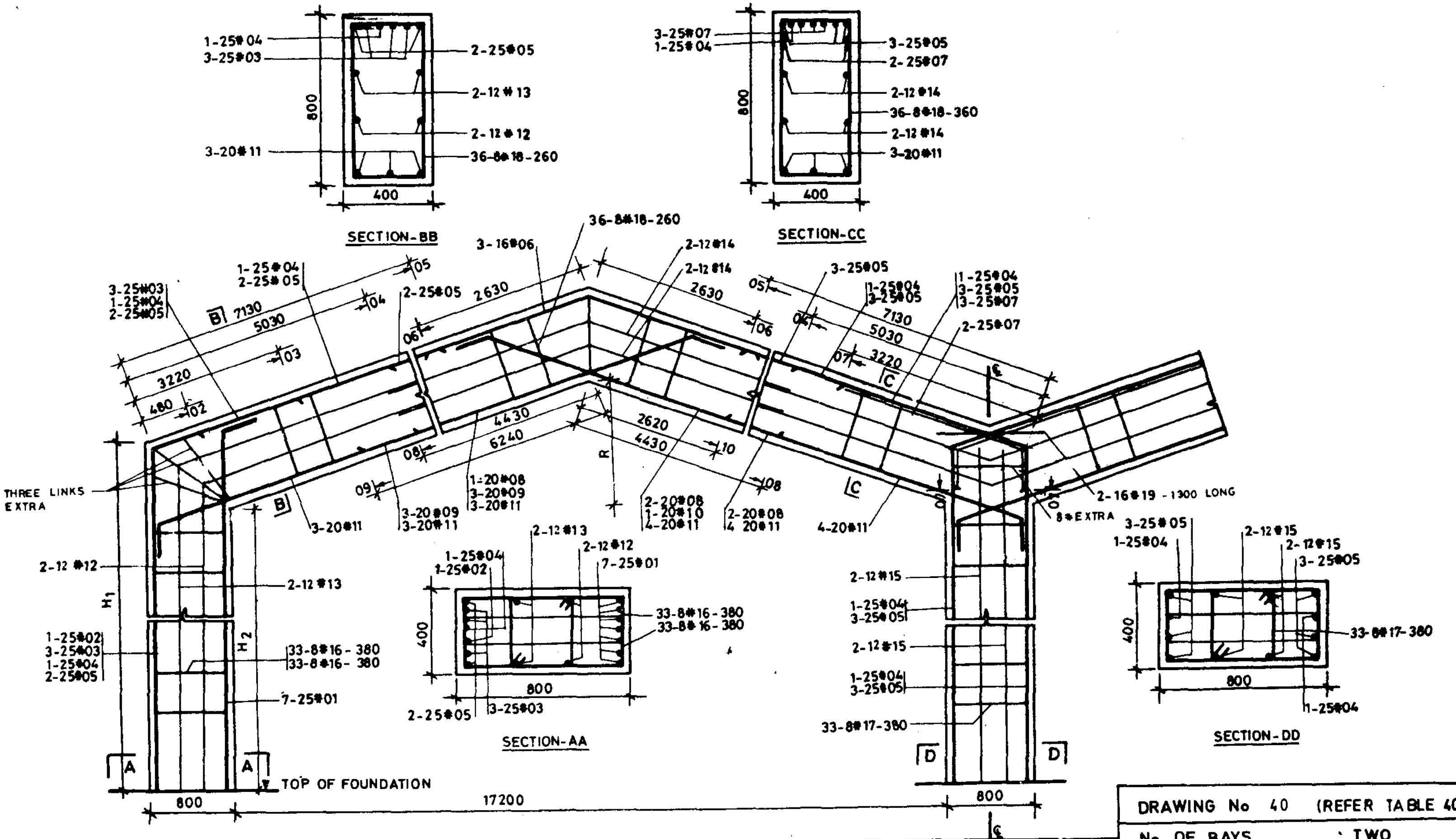
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1in3	9789	9212	2867	8	1350	8	1286
1in4	9813	9188	2150	8	1319	8	1254
1in5	9828	9172	1720	8	1304	8	1239

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANAYSIS TABLE : 39
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360
   c. VALLEY : 550

DRAWING No 39 (REFER TABLE 39)

No. OF BAYS	: TWO
SPAN	: 18.0 m
SPACING	: 12.0 m
COLUMN HEIGHT	: 9.5 m
SUPPORT CONDITION	: FIXED
FOR ALL WIND AND SEISMIC ZONES	
MATERIALS:	
CONCRETE	: M 25
STEEL	: Fe 415



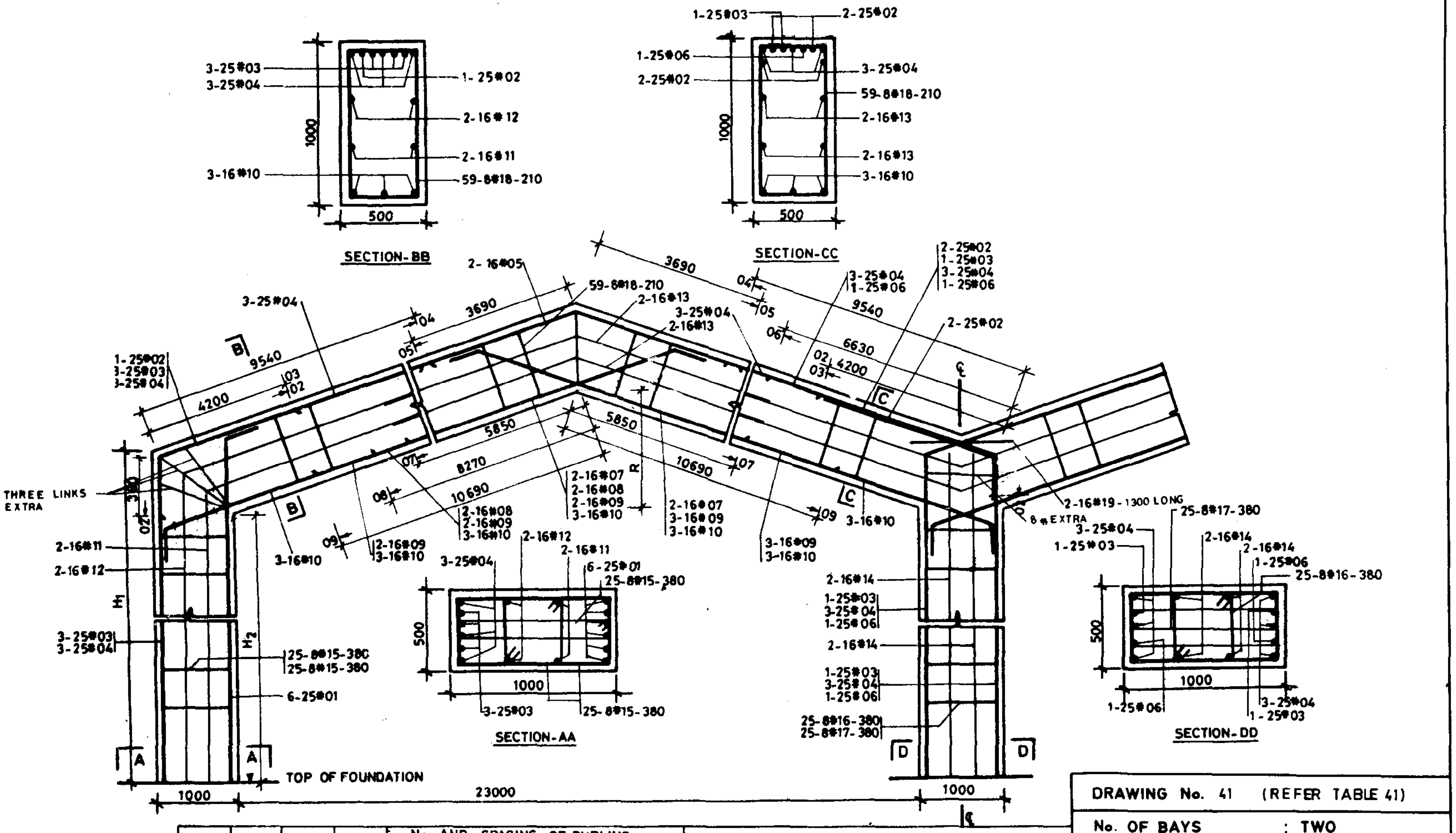
SLOPE	H_1	H_2	R	No AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No OF PURLINS	SPACING	No OF PURLINS	SPACING
1 in 3	12789	12212	2867	8	1350	8	1286
1 in 4	12813	12188	2150	8	1319	8	1254
1 in 5	12828	12172	1720	8	1304	8	1239

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE: 40
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360
   c. VALLEY : 550

DRAWING No 40 (REFER TABLE 40)

No. OF BAYS : TWO
SPAN : 18.0 m
SPACING : 12.0 m
COLUMN HEIGHT : 12.5 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M25
STEEL : Fe 415



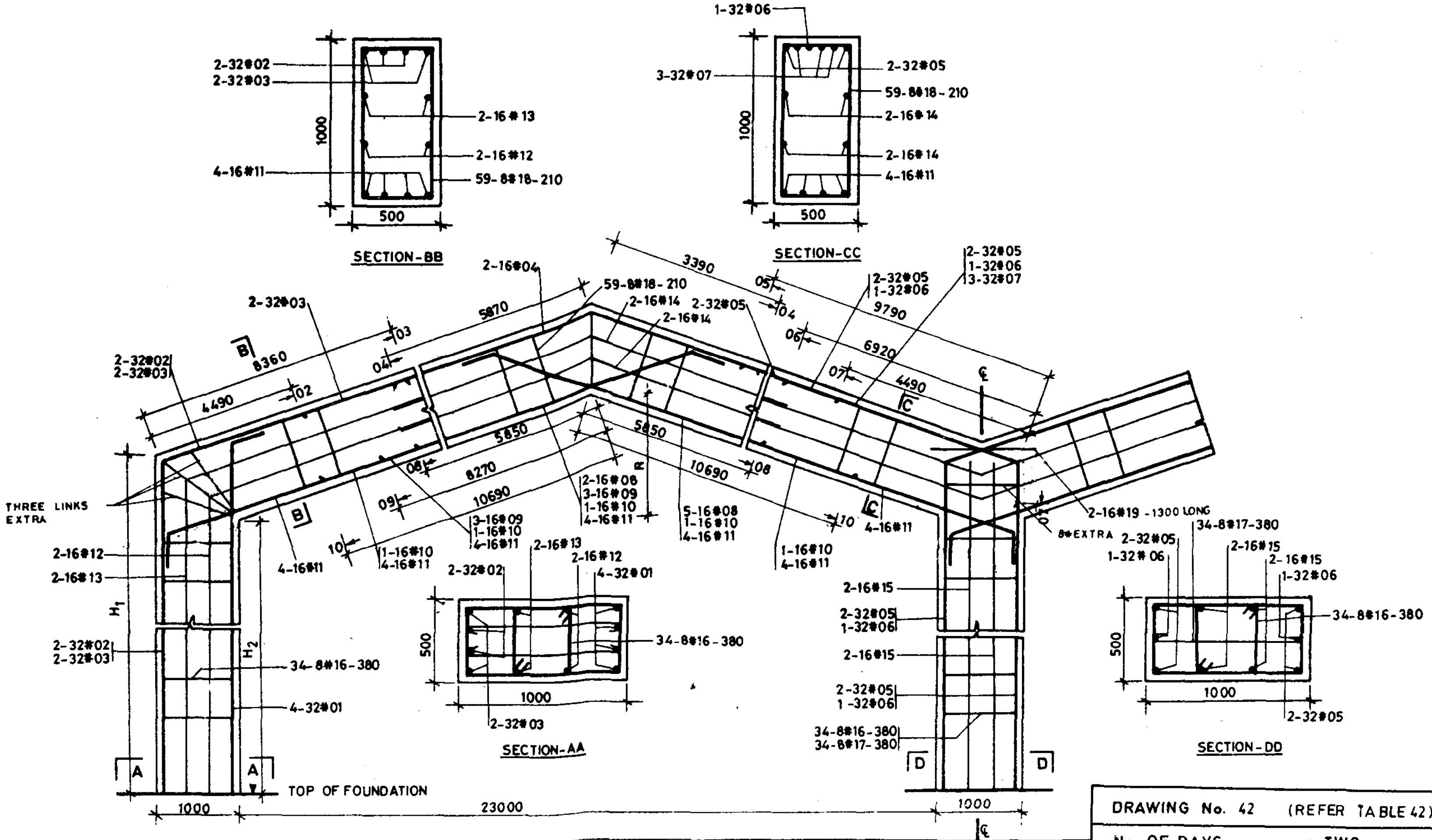
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No OF PURLINS	SPACING	No OF PURLINS	SPACING
1in3	9861	9140	3833	11	1278	10	1311
1in4	9891	9110	2875	10	1387	10	1280
1in5	9910	9090	2300	10	1372	10	1265

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE:41
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300
   c. VALLEY : 550

DRAWING No. 41 (REFER TABLE 41)

No. OF BAYS : TWO
SPAN : 24.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 9.5 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS :
CONCRETE : M 25
STEEL : Fe 415



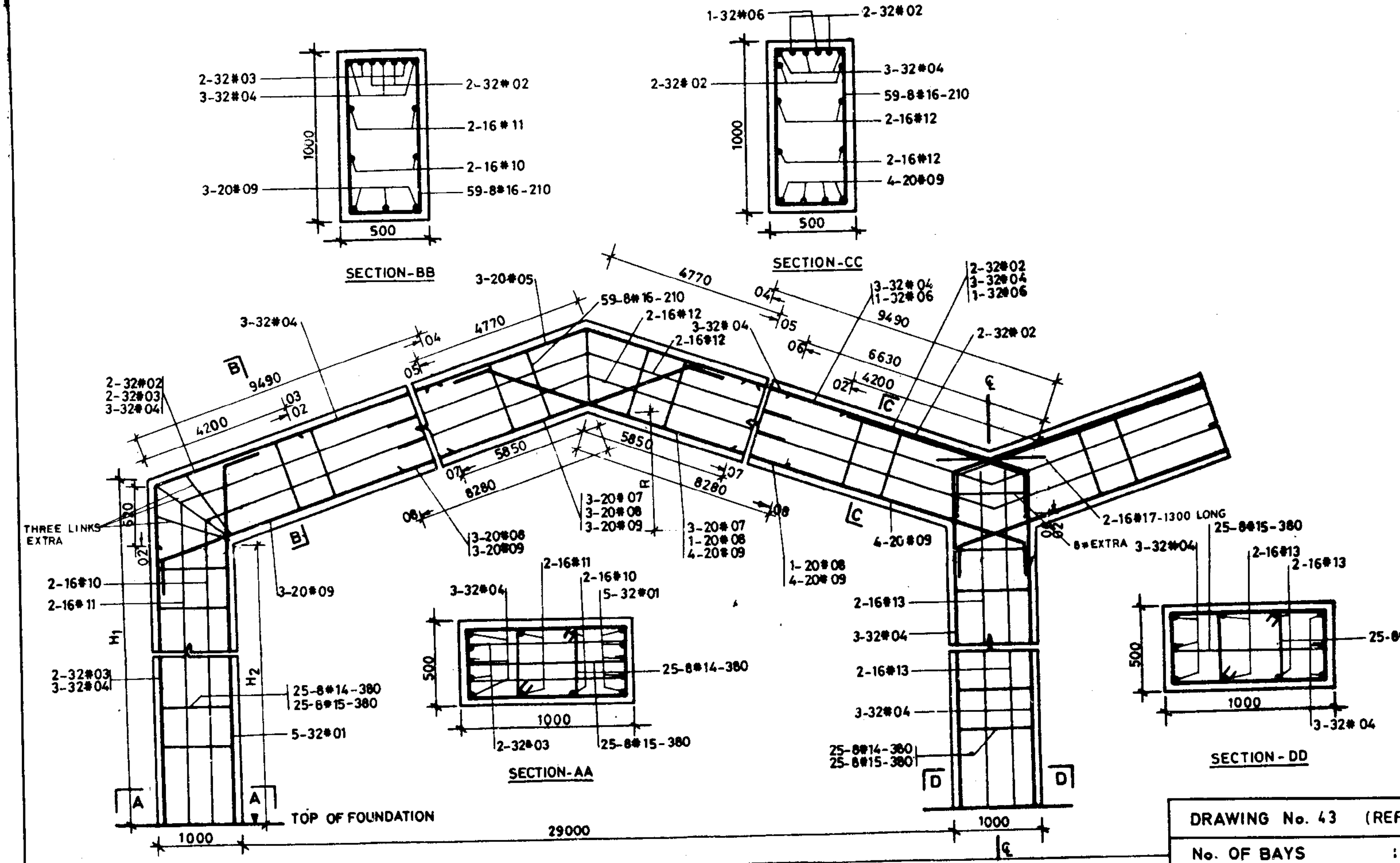
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1in 3	12861	12140	3833	11	1278	10	1311
1in 4	12891	12110	2875	10	1387	10	1280
1in 5	12910	12090	2300	10	1372	10	1265

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 42
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300
   c. VALLEY : 550

DRAWING No. 42 (REFER TABLE 42)

No. OF BAYS : TWO
SPAN : 24.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 12.5 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M 25
STEEL : Fe415



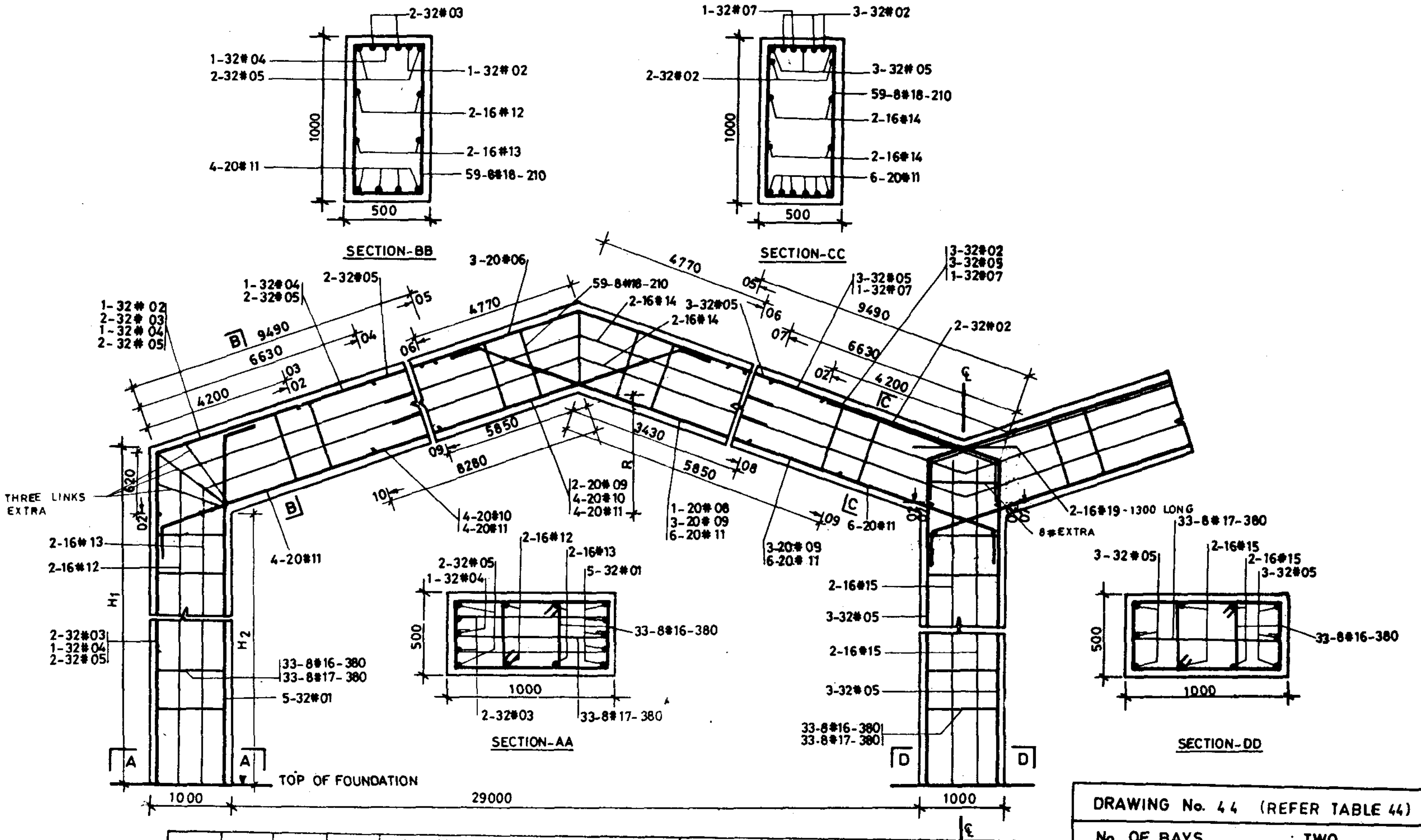
SLOPE	H1	H2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	9861	9140	3833	11	1272	10	1304
1 in 4	9891	9110	2875	10	1380	10	1273
1 in 5	9910	9090	2300	10	1365	10	1258

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE: 43
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360
   c. VALLEY : 550

DRAWING No. 43 (REFER TABLE 43)

No. OF BAYS	: TWO
SPAN	: 24.0 m
SPACING	: 12.0 m
COLUMN HEIGHT	: 9.5 m
SUPPORT CONDITION	: FIXED
FOR ALL WIND AND SEISMIC ZONES	
MATERIALS :	
CONCRETE	: M 25
STEEL	: Fe415



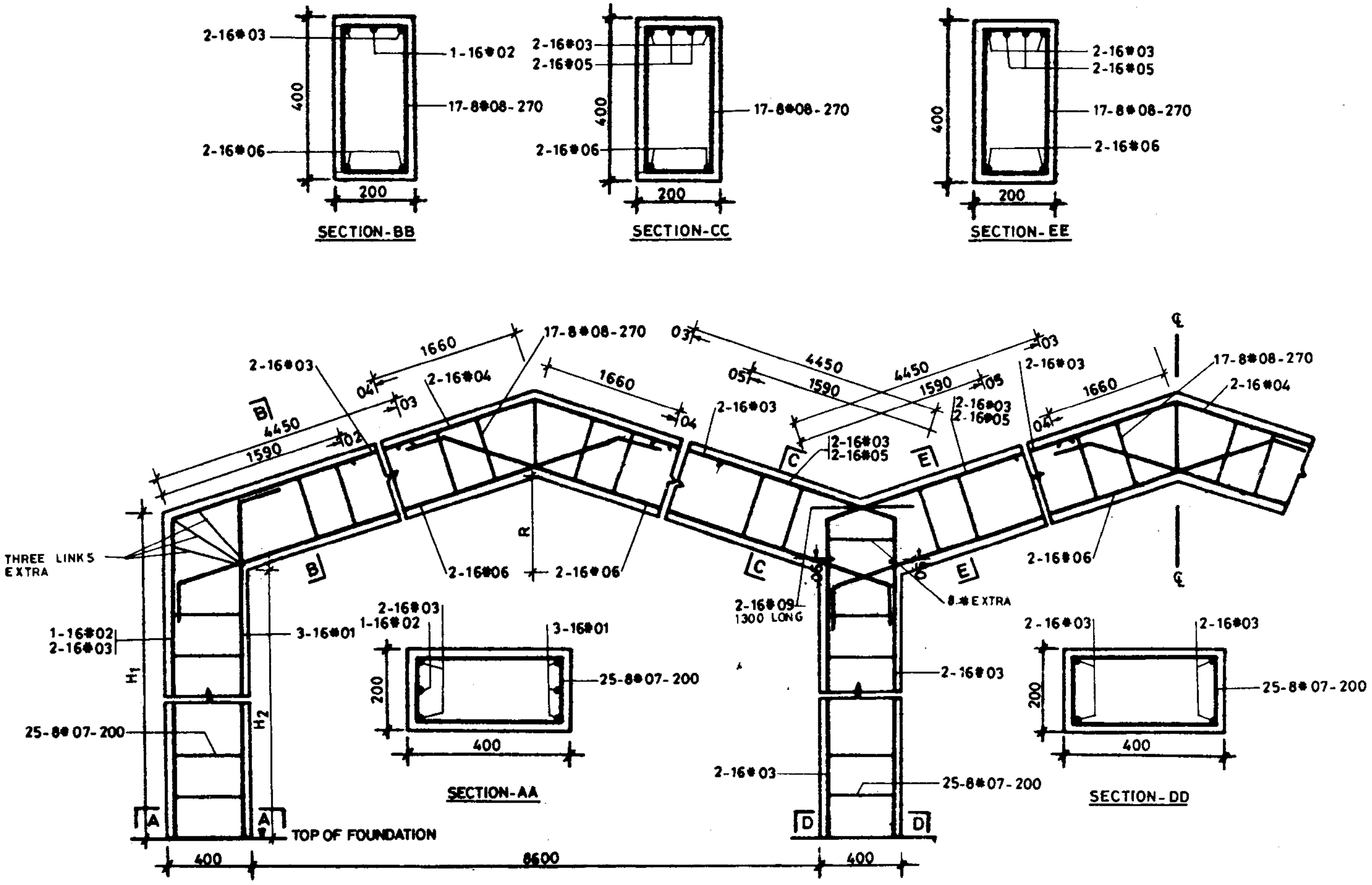
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1in3	12861	12140	3833	11	1272	10	1304
1in4	12891	12110	2875	10	1380	10	1273
1in4	12910	12090	2300	10	1365	10	1258

NOTE :

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 44
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   - a EXTERNAL COLUMN FACE : 100
   - b. RIDGE : 360
   - c. VALLEY : 550

DRAWING No. 44 (REFER TABLE 44)

No. OF BAYS	:	TWO
SPAN	:	24.0 m
SPACING	:	12.0 m
COLUMN HEIGHT	:	12.5 m
SUPPORT CONDITION	:	FIXED
FOR ALL WIND AND SEISMIC ZONES		
MATERIALS :		
CONCRETE	:	M 25
STEEL	:	Fe 415



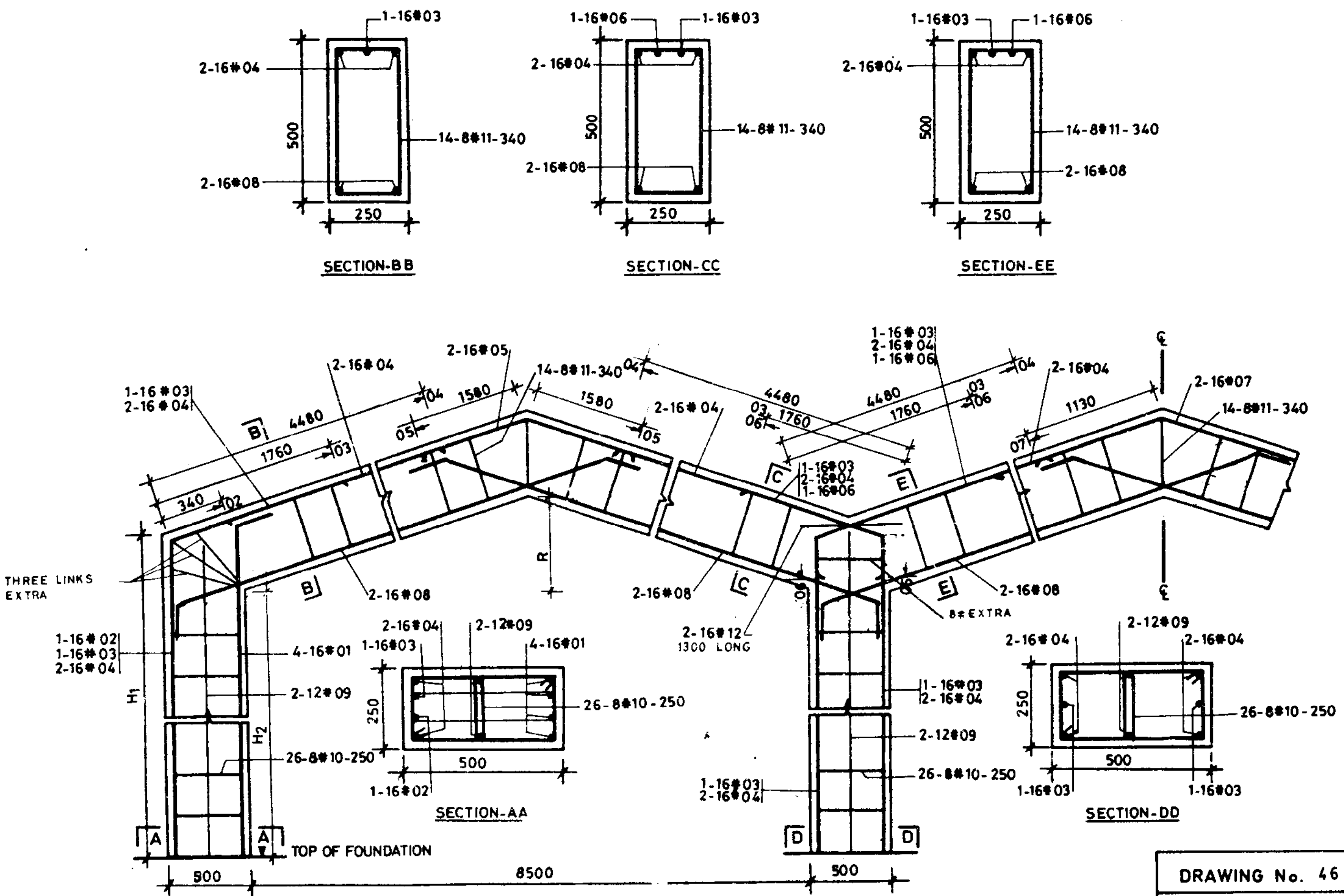
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	5144	4856	1433	5	1139	4	1381
1 in 4	5156	4844	1075	5	1111	4	1346
1 in 5	5164	4836	860	5	1098	4	1330

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE:45
3. DISTANCE OF THE NEAREST PURLIN LUG (Ȼ) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300
   c. VALLEY : 300

DRAWING No. 45 (REFER TABLE 45)

No. OF BAYS : THREE
SPAN : 9.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 5.0 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415



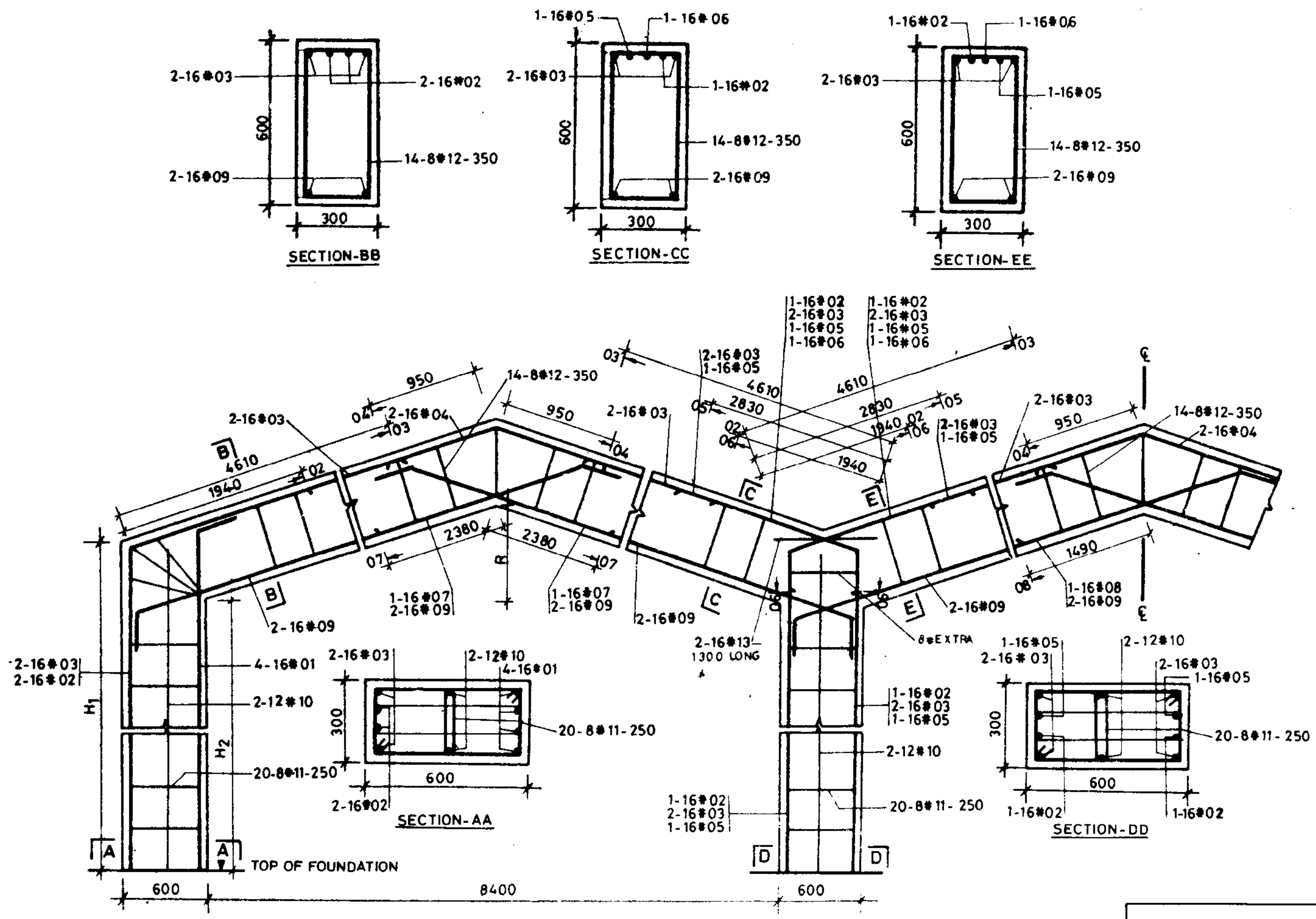
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1in3	6680	6320	1470	5	1151	4	1381
1in4	6695	6305	1063	5	1124	4	1346
1in5	6705	6295	850	5	1111	4	1330

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 46
3. DISTANCE OF THE NEAREST PURLIN WG (℄) FROM THE a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300
   c. VALLEY : 300

DRAWING No. 46 (REFER TABLE 46)

No. OF BAYS : THREE
SPAN : 9.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 6.5 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415



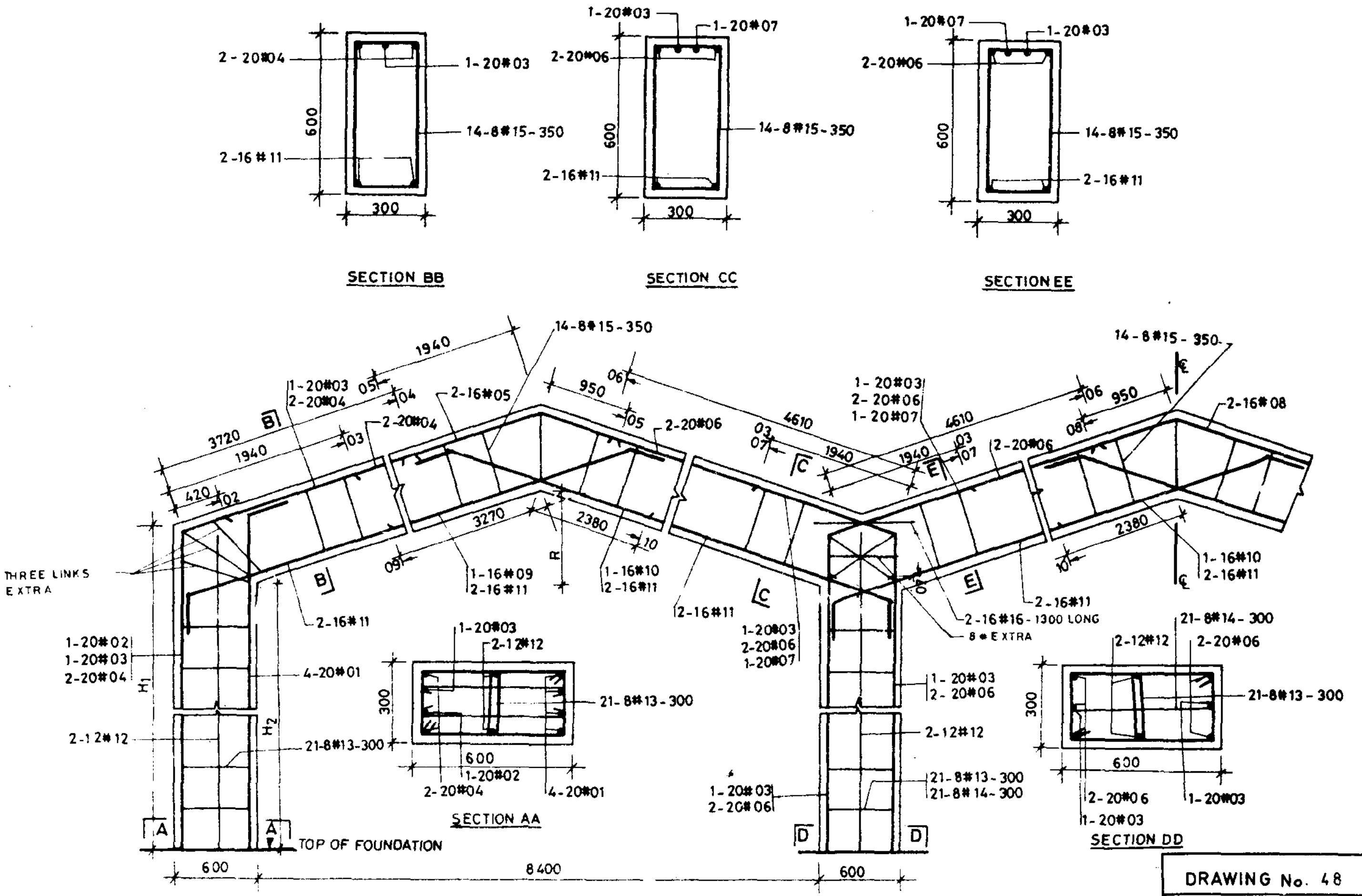
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1in3	5217	4784	1400	5	1150	4	1361
1in4	5234	4766	1050	5	1122	4	1326
1in5	5246	4754	840	5	1109	4	1310

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 47
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   - a EXTERNAL COLUMN FACE : 100
   - b. RIDGE : 360
   - c. VALLEY : 300

DRAWING No. 47 (REFER TABLE 47)

No. OF BAYS : THREE
SPAN : 9.0 m
SPACING : 12.0 m
COLUMN HEIGHT : 5.0 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415



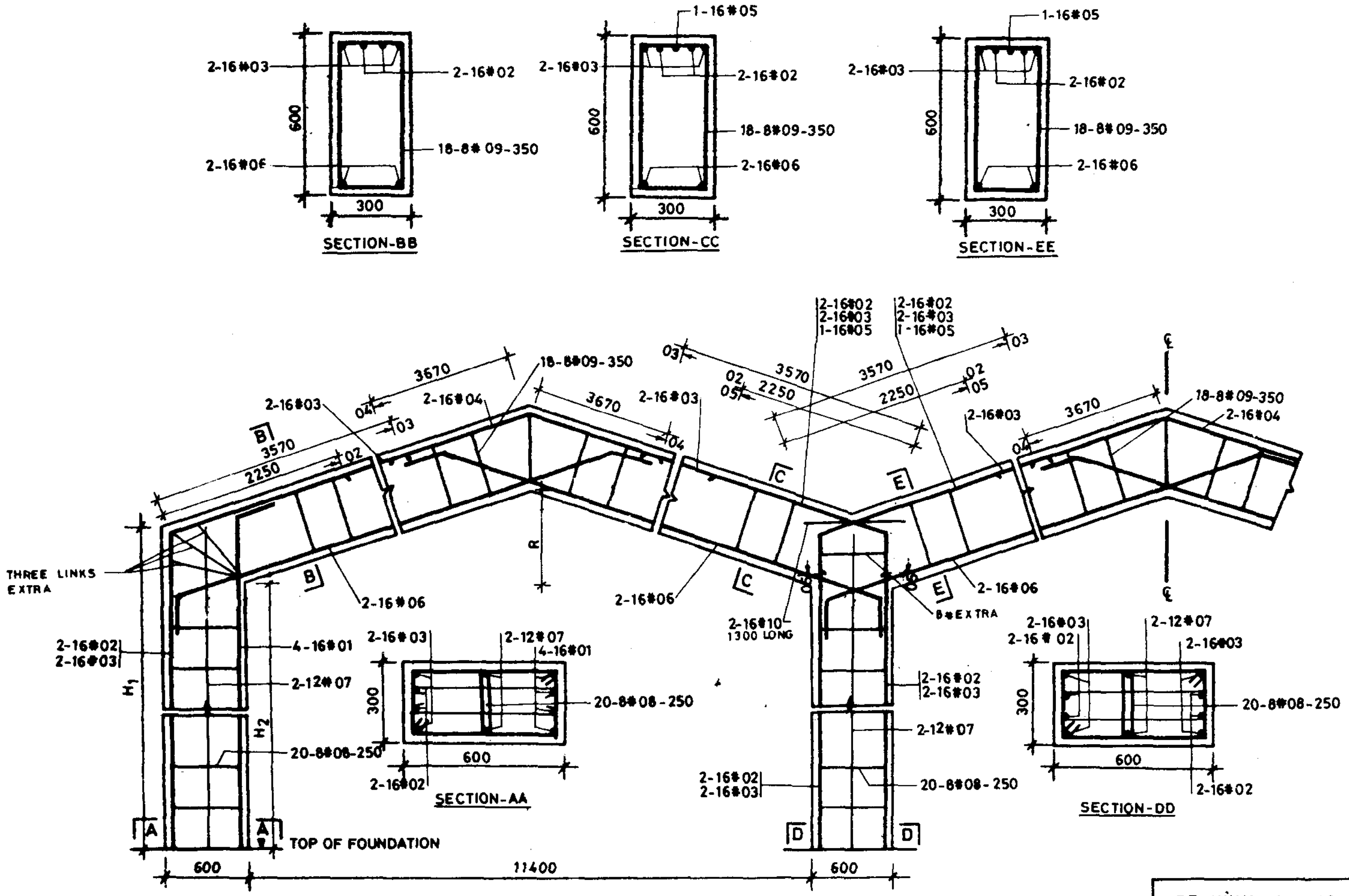
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No OF PURLINS	SPACING
1 in 3	6717	6284	1400	5	1150	4	1361
1 in 4	6734	6266	1050	5	1122	4	1326
1 in 5	6746	6254	840	5	1109	4	1310

NOTE:

1. ALL DIMENSIONS ARE IN mm.
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 48
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360
   c. VALLEY : 300

DRAWING No. 48 (REFER TABLE 48)

No. OF BAYS	: THREE
SPAN	: 9.0 m
SPACING	: 12.0 m
COLUMN HEIGHT	: 6.5 m
SUPPORT CONDITION	: FIXED
FOR ALL WIND AND SEISMIC ZONES	
MATERIALS:	
CONCRETE	: M 25
STEEL	: Fe 415



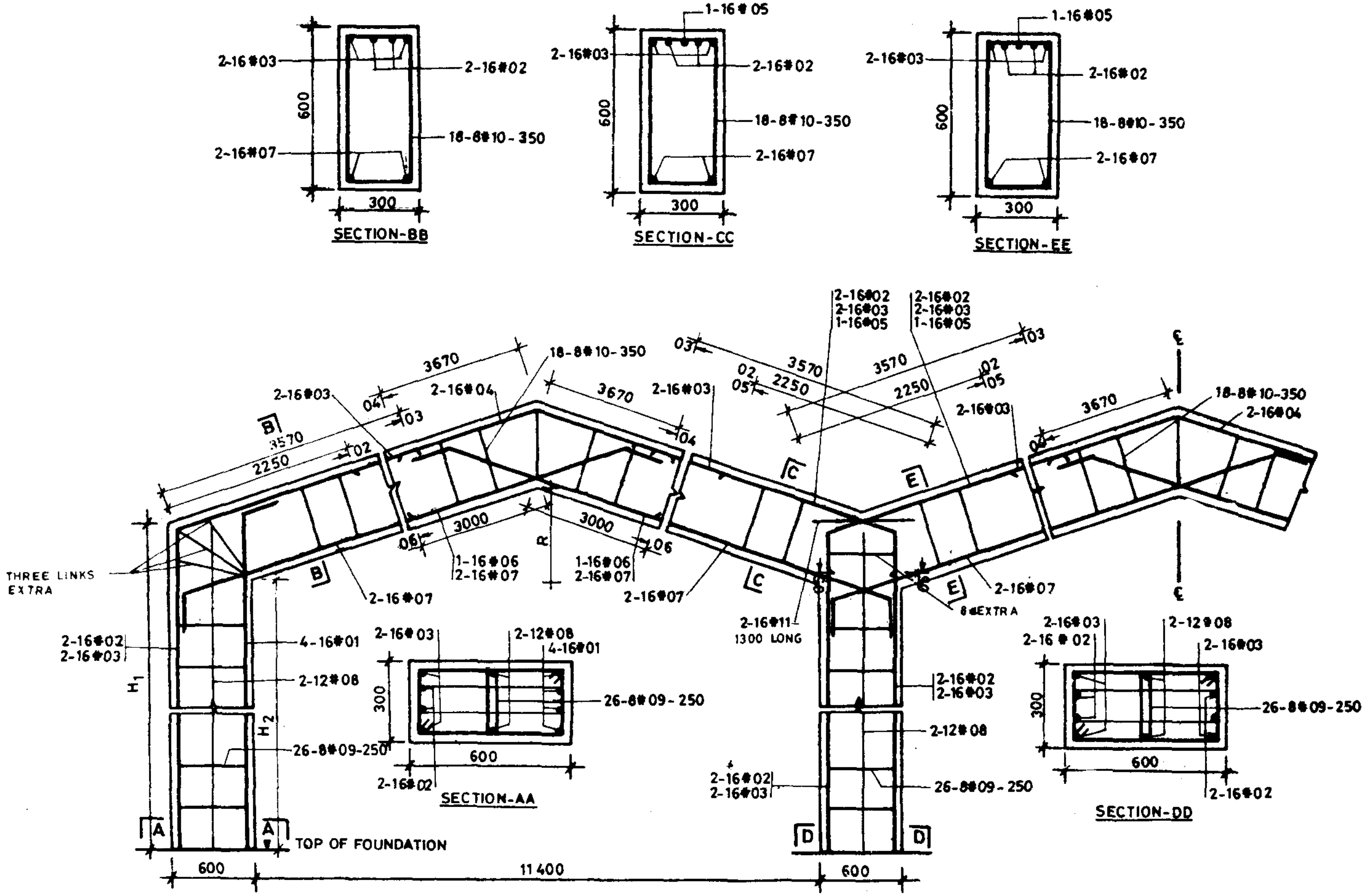
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1in 3	5217	4784	1900	6	1248	6	1145
1in4	5234	4766	1425	6	1219	5	1396
1in5	5246	4754	1140	6	1205	5	1380

NOTE :

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE: 49
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300
   c. VALLEY : 300

DRAWING No. 49 (REFER TABLE 49)

No. OF BAYS	: THREE
SPAN	: 12.0 m
SPACING	: 6.0 m
COLUMN HEIGHT	: 5.0 m
SUPPORT CONDITION	: FIXED
FOR ALL WIND AND SEISMIC ZONES	
MATERIALS:	
CONCRETE	: M 25
STEEL	: Fe 415



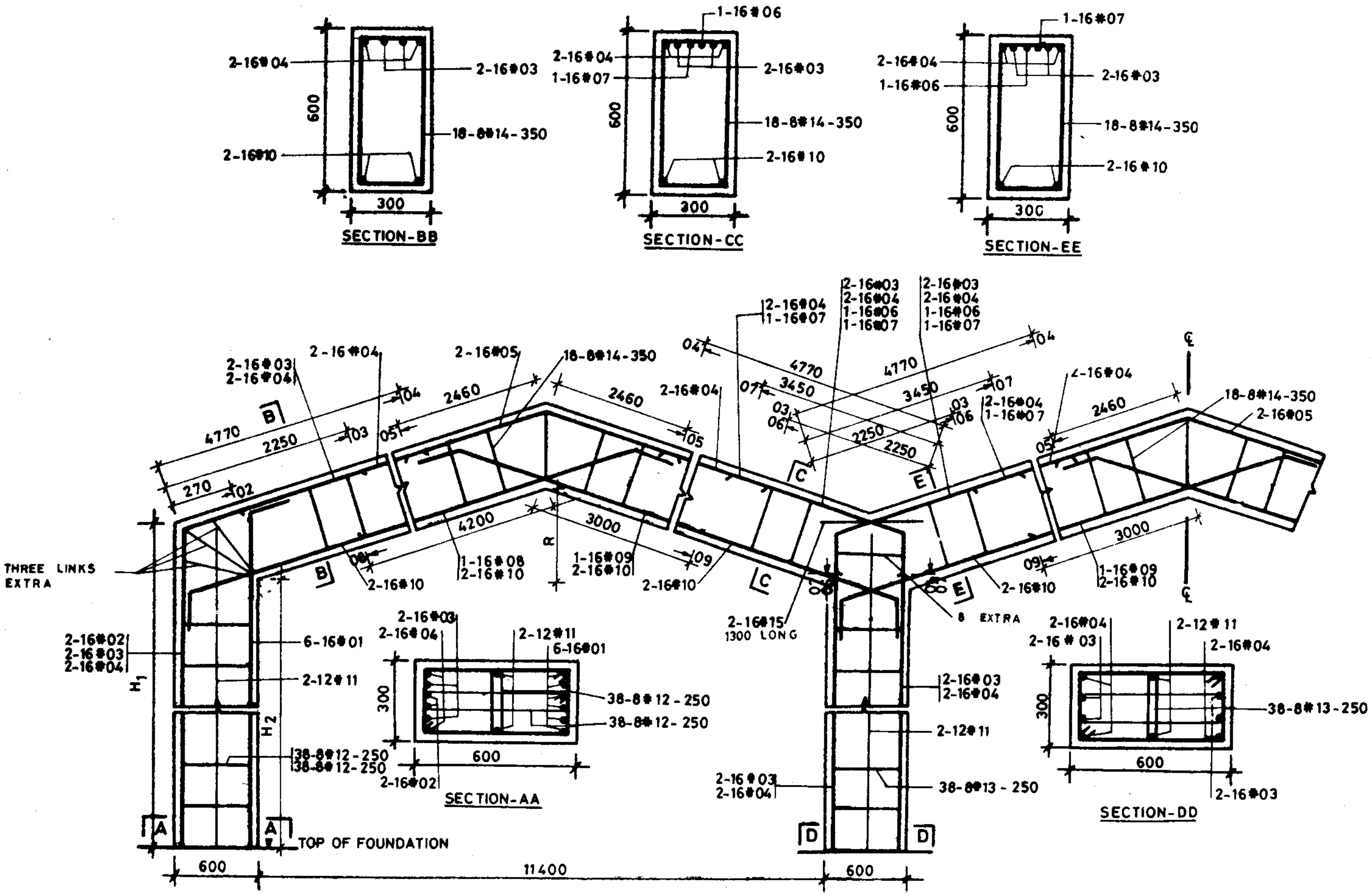
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	6717	6284	1900	6	1248	6	1145
1 in 4	6734	6266	1425	6	1219	5	1396
1 in 5	6746	6254	1140	6	1205	5	1380

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 50
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE: 100
   b. RIDGE : 300
   c. VALLEY : 300

DRAWING No. 50 (REFER TABLE 50)

No. OF BAYS : THREE
SPAN : 12.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 6.5 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415



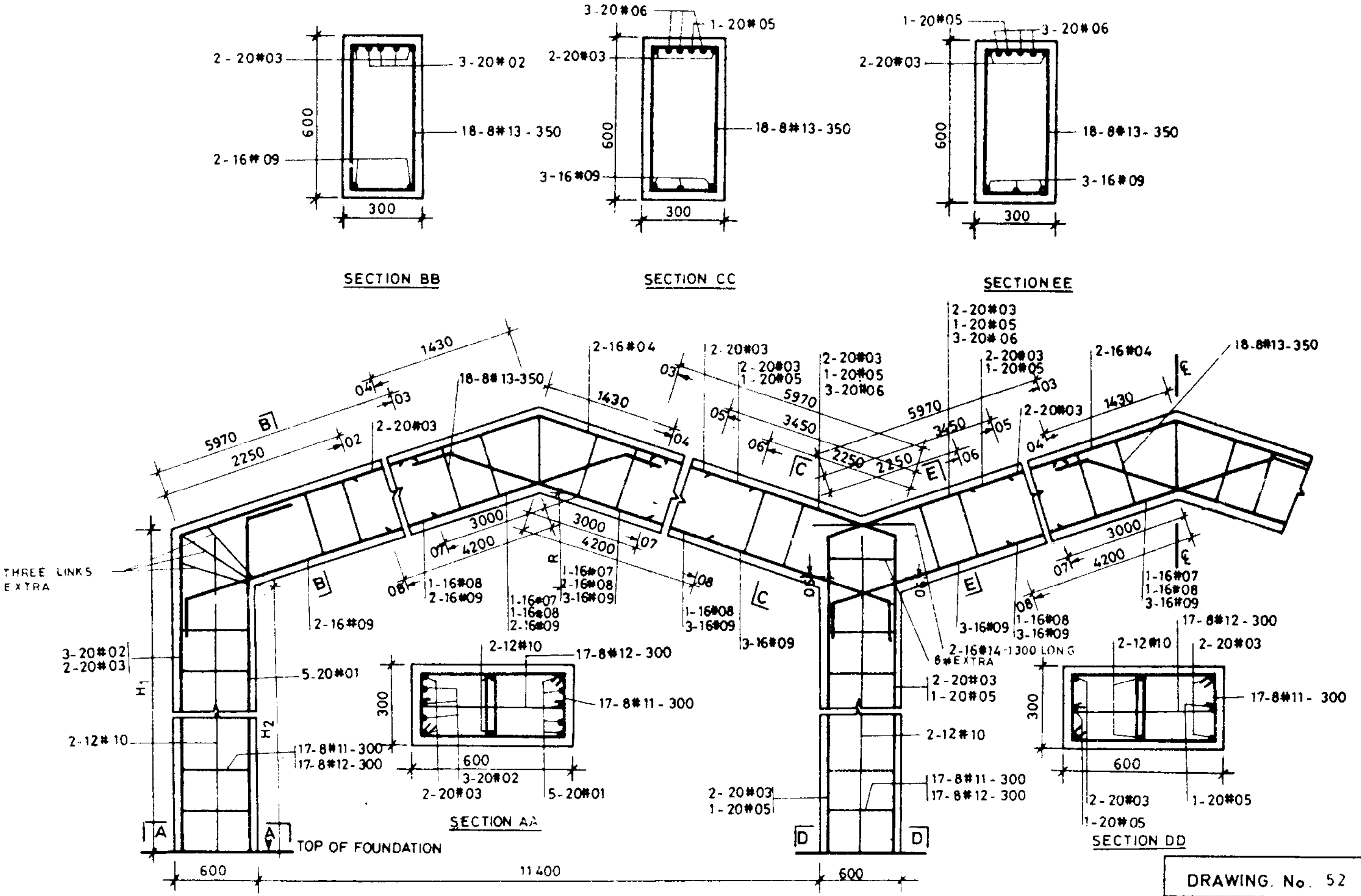
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	9717	9284	1900	6	1248	6	1145
1 in 4	9734	9266	1425	6	1219	5	1396
1 in 5	9746	9254	1140	6	1205	5	1380

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 51
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300
   c. VALLEY : 300

DRAWING No. 51 (REFER TABLE 51)

No. OF BAYS : THREE
SPAN : 12.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 9.5 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415



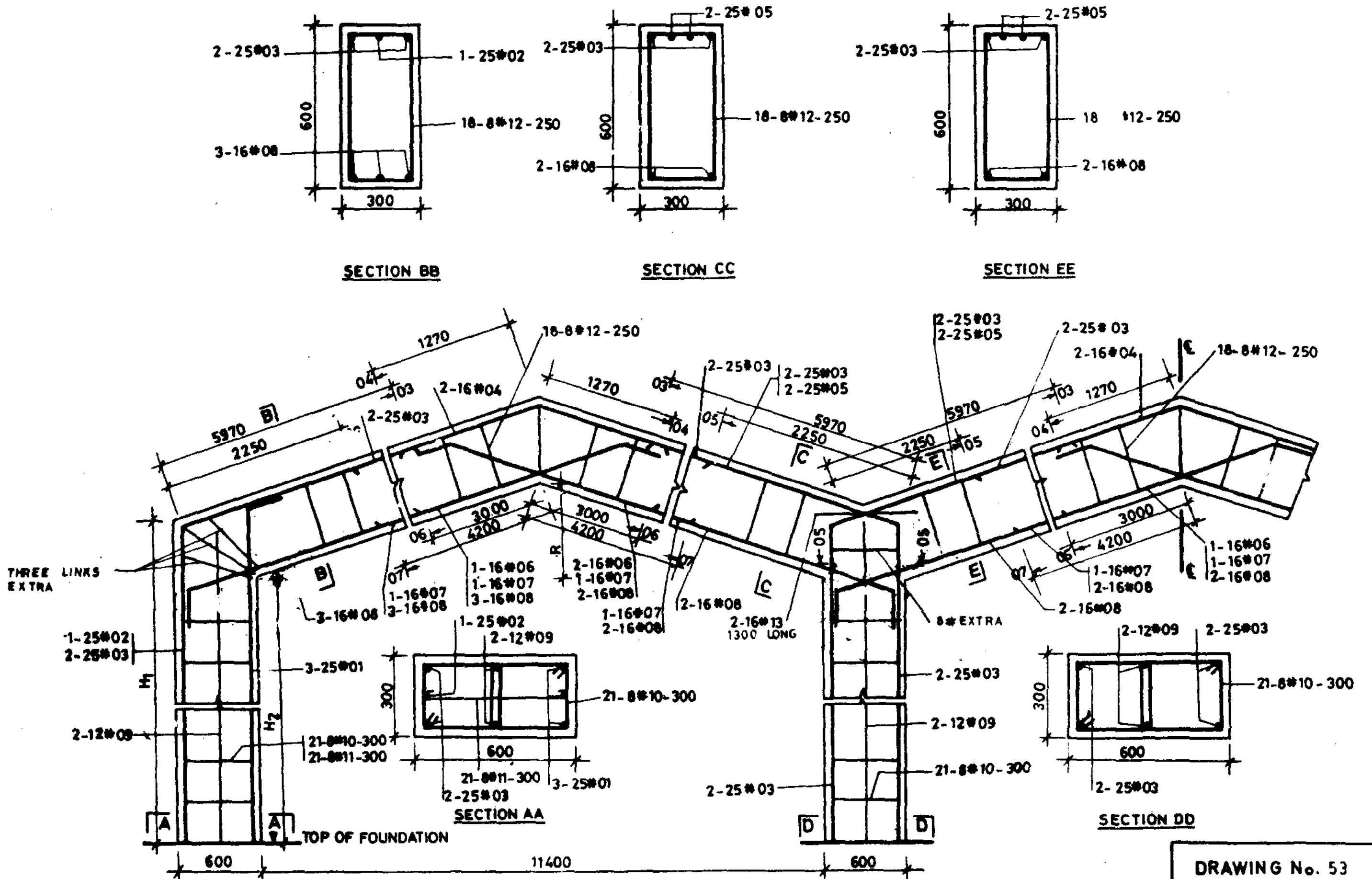
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	5217	4784	1900	6	1236	6	1133
1 in 4	5234	4766	1425	6	1207	5	1381
1 in 5	5246	4754	1140	6	1193	5	1365

NOTE:

1. ALL DIMENSIONS ARE IN mm.
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 52
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   - a EXTERNAL COLUMN FACE : 100
   - b. RIDGE : 360
   - c VALLEY : 300

DRAWING. No. 52 (REFER TABLE 52)

No. OF BAYS : THREE
SPAN : 12.0 m
SPACING : 12.0 m
COLUMN HEIGHT : 5.0 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415



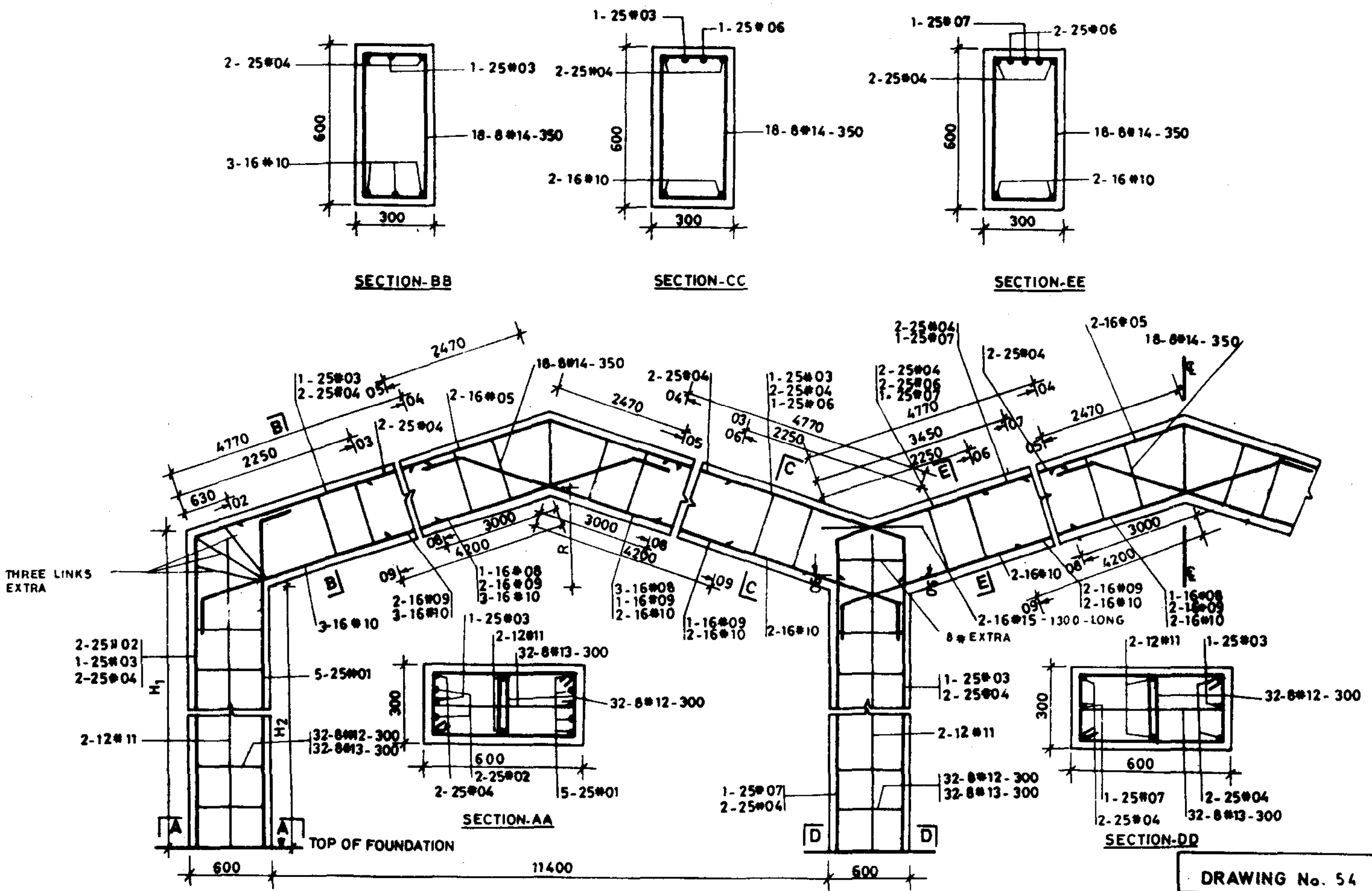
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLIN	SPACING	No. OF PURLIN	SPACING
1 in 3	6717	6177	2007	6	1236	6	1133
1 in 4	6734	6154	1538	6	1207	5	1381
1 in 5	6746	6138	1256	6	1193	5	1365

NOTE:

1. ALL DIMENSIONS ARE IN mm.
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 53
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360
   c. VALLEY : 300

DRAWING No. 53 (REFER TABLE 53)

No. OF BAYS : THREE
SPAN : 12.0 m
SPACING : 12.0 m
COLUMN HEIGHT : 6.5 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M25
STEEL : Fe 415



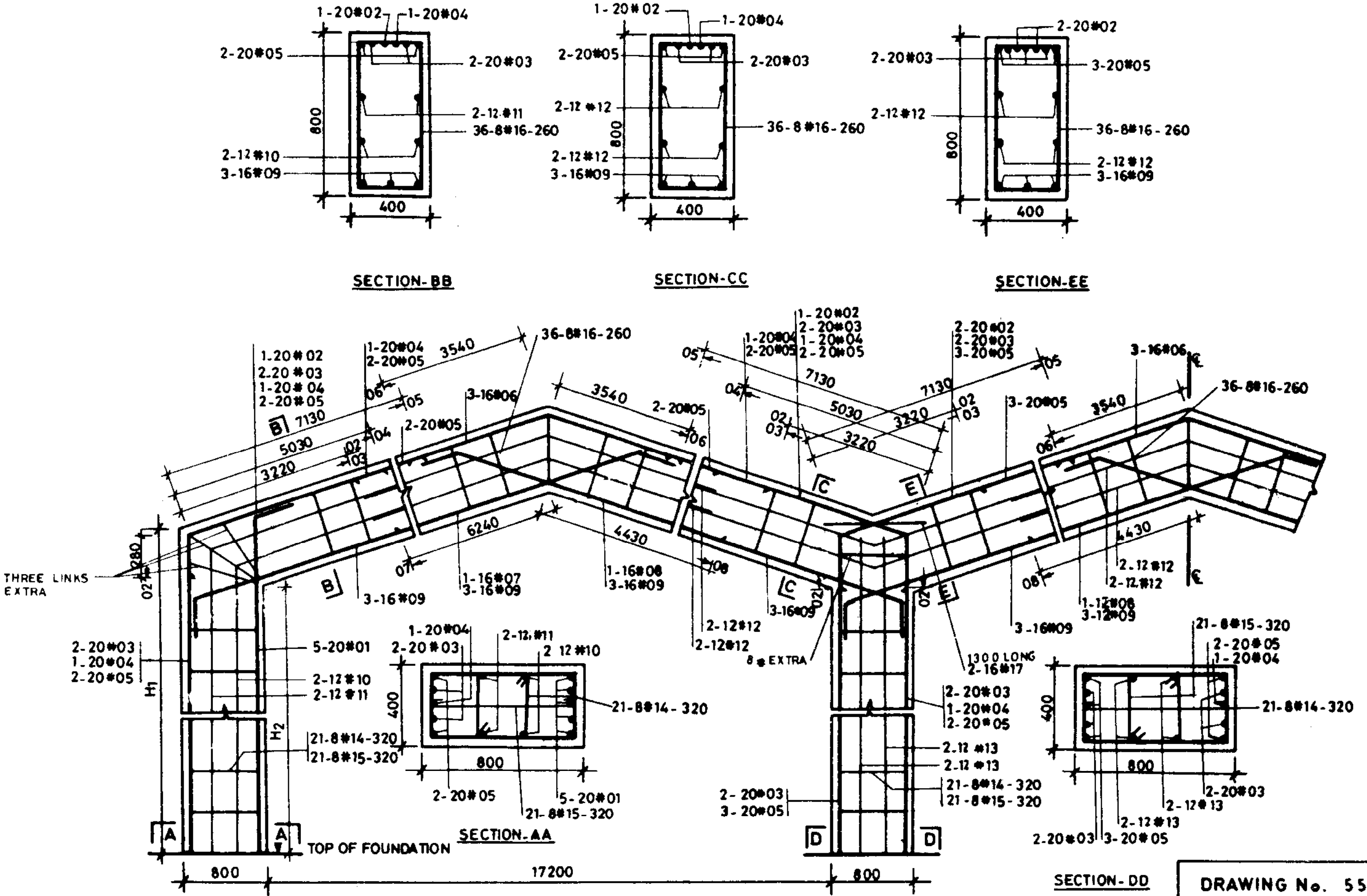
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1in 3	9717	9284	1900	6	1236	6	1133
1in 4	9734	9266	1425	6	1207	5	1381
1in 5	9746	9254	1140	6	1193	5	1365

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE: 54
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   - a. EXTERNAL COLUMN FACE : 100
   - b. RIDGE : 360
   - c. VALLEY : 300

DRAWING No. 54 (REFER TABLE 54)

No. OF BAYS : THREE
SPAN : 12.0 m
SPACING : 12.0 m
COLUMN HEIGHT : 9.5 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS :
CONCRETE : M 25
STEEL : Fe 415



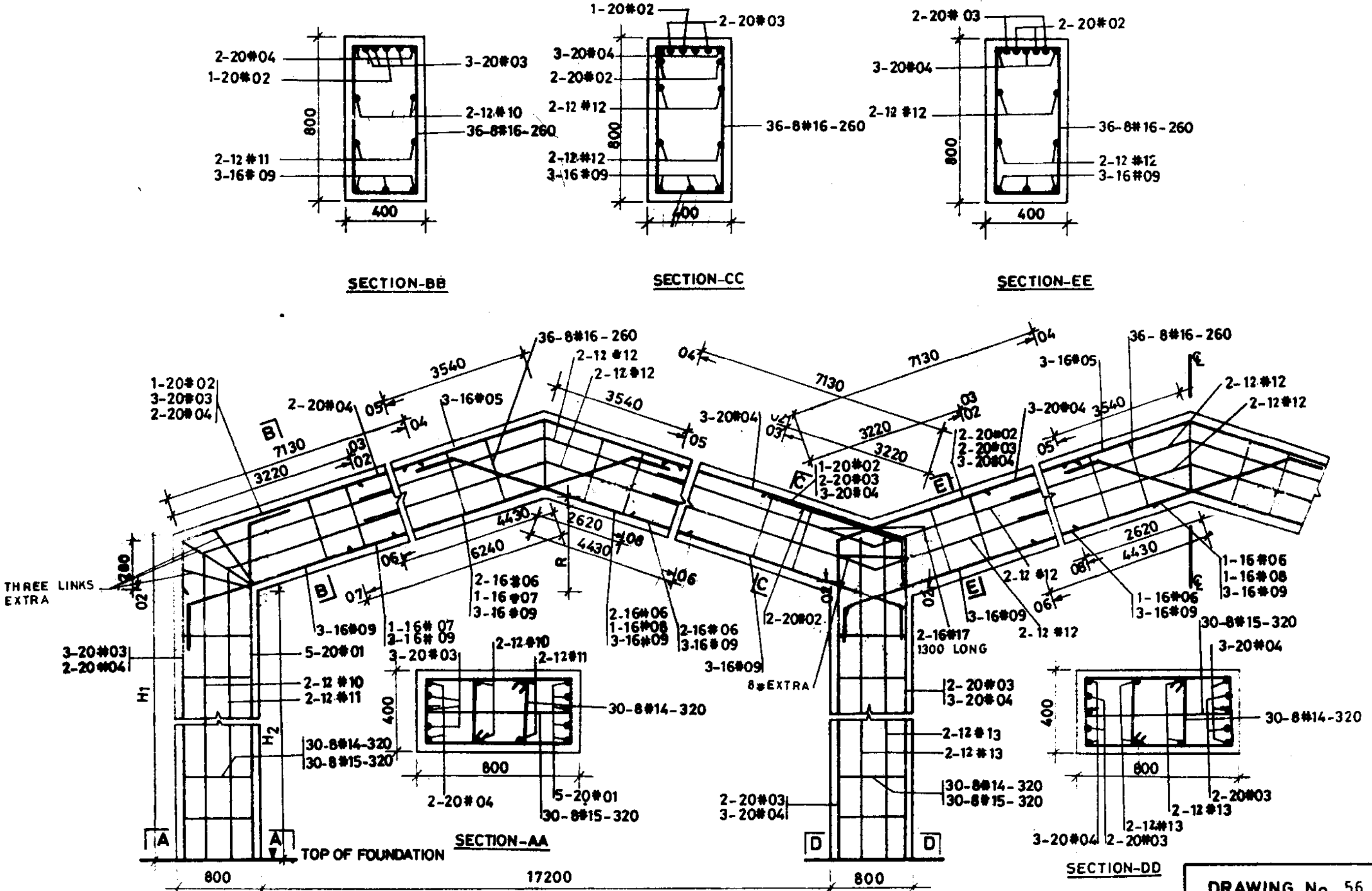
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	6789	6212	2867	8	1358	8	1270
1 in 4	6813	6188	2150	8	1327	8	1240
1 in 5	6828	6172	1720	8	1312	8	1225

NOTE:

1. ALL DIMENSIONS ARE IN mm.
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 55
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300
   c. VALLEY : 300

DRAWING No. 55 (REFER TABLE 55)

No. OF BAYS : THREE
SPAN : 18.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 6.5 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES :
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415



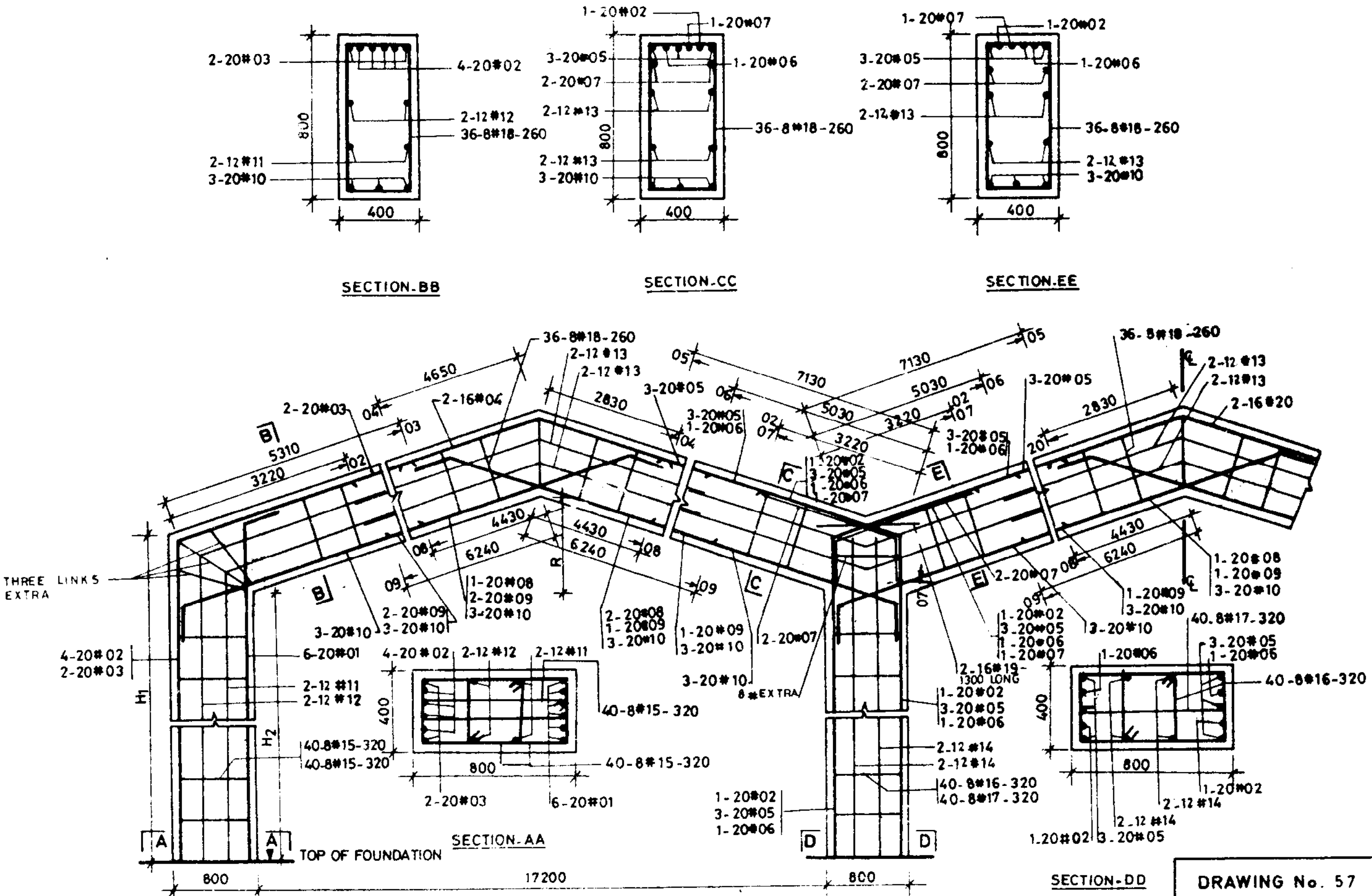
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	9789	9212	2867	8	1358	8	1270
1 in 4	9813	9188	2150	8	1327	8	1240
1 in 5	9828	9172	1720	8	1312	8	1226

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 56
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   - a. EXTERNAL COLUMN FACE : 100
   - b. RIDGE : 300
   - c. VALLEY : 300

DRAWING No. 56 (REFER TABLE 56)

No. OF BAYS : THREE
SPAN : 18.0m
SPACING : 6.0 m
COLUMN HEIGHT : 9.5 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES :
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415



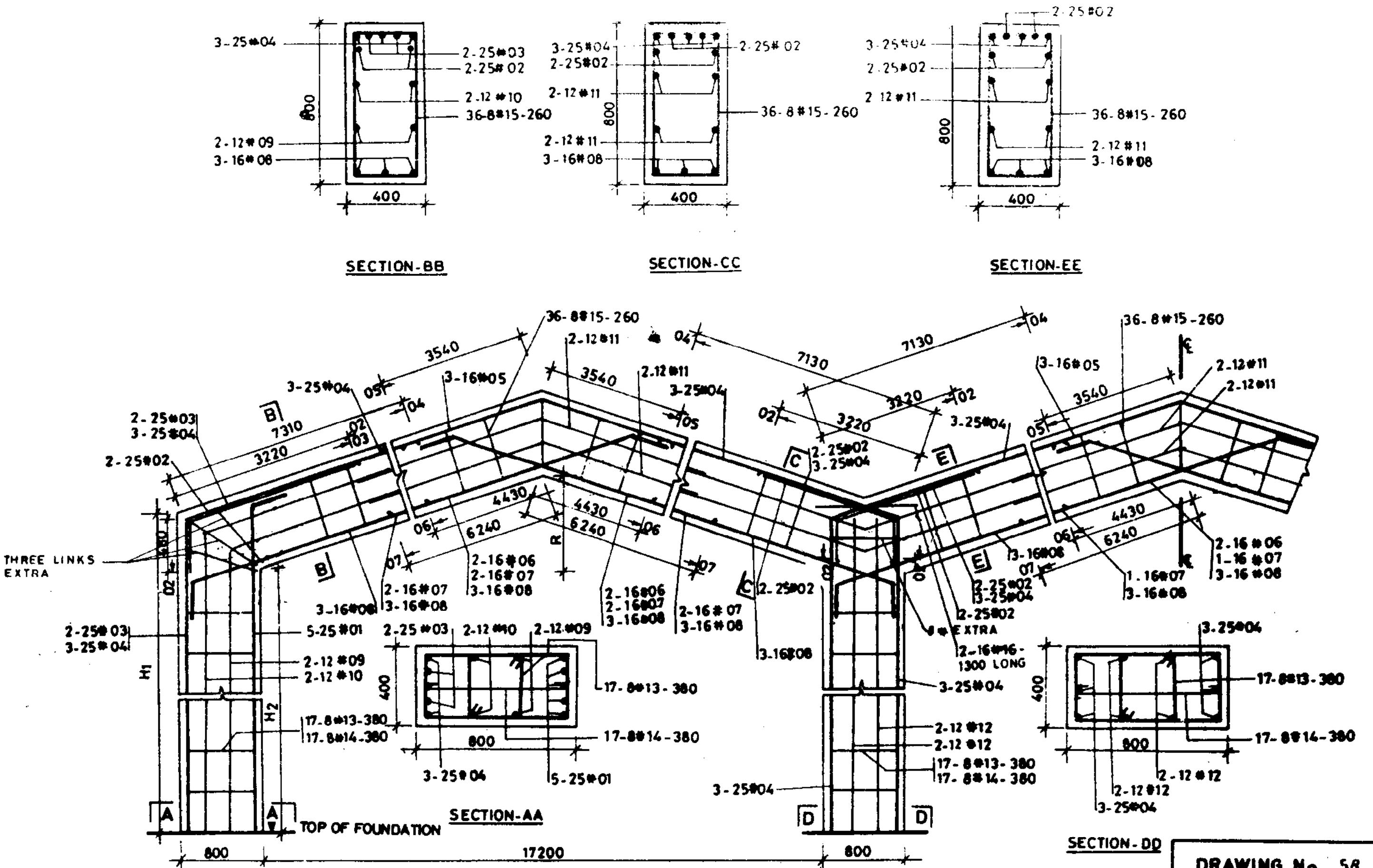
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	12789	12212	2867	8	1358	8	1270
1 in 4	12813	12188	2150	8	1327	8	1240
1 in 5	12828	12172	1720	8	1312	8	1225

NOTE:

1. ALL DIMENSIONS ARE IN mm.
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE: 57
3. DISTANCE OF THE NEAREST PURLIN LUG(℄) FROM THE a. EXTERNAL COLUMN FACE: 100
   b. RIDGE : 300
   c. VALLEY : 300

DRAWING No. 57 (REFER TABLE 57)

No. OF BAYS	:	THREE
SPAN	:	18.0 m
SPACING	:	6.0 m
COLUMN HEIGHT	:	12.5 m
SUPPORT CONDITION	:	FIXED
FOR ALL WIND AND SEISMIC ZONES	:	
MATERIALS :		
CONCRETE	:	M 25
STEEL	:	Fe415



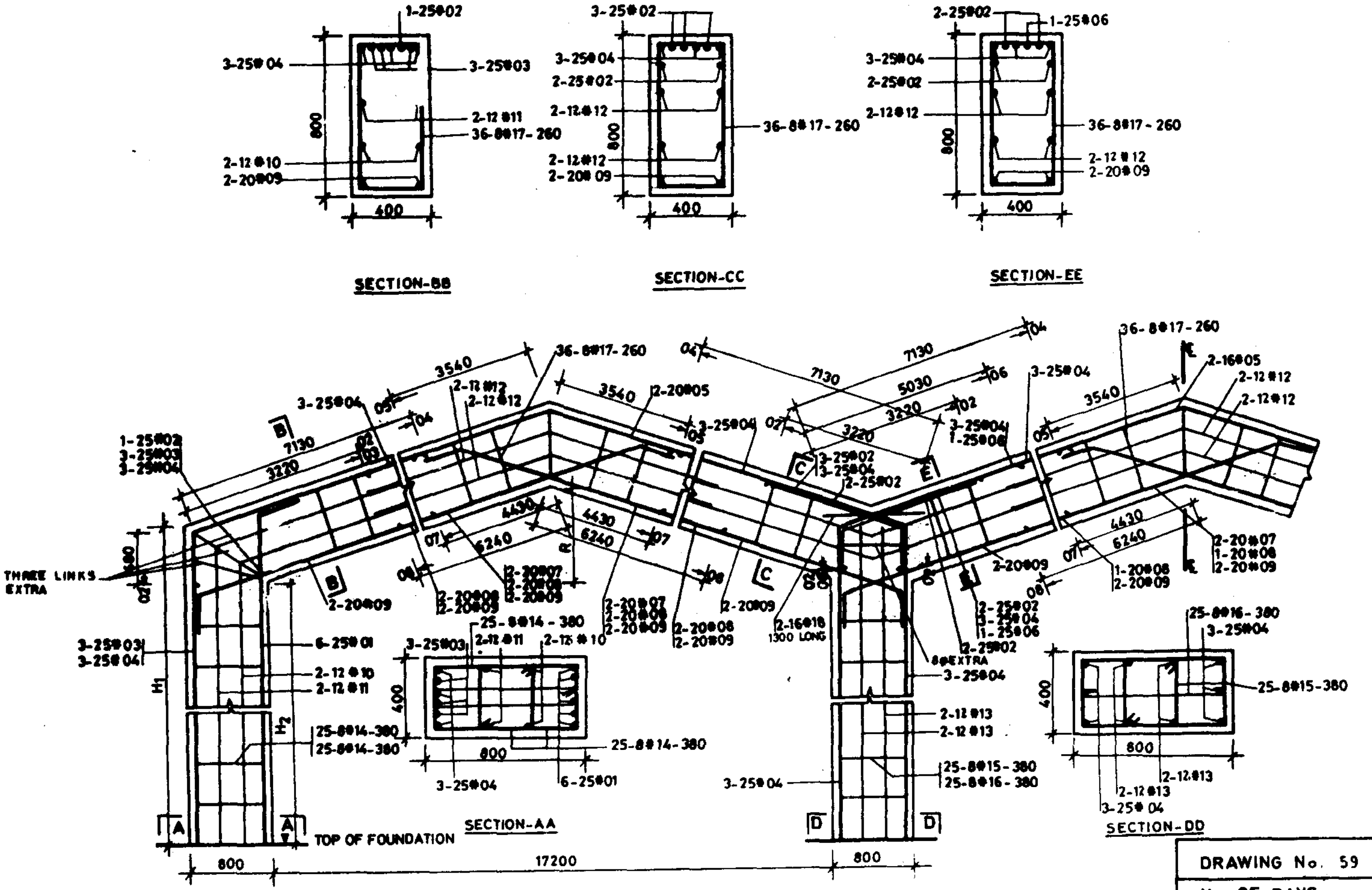
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	6789	6135	2944	8	1350	8	1286
1 in 4	6813	6108	2232	8	1319	8	1254
1 in 5	6828	6086	1806	8	1304	8	1239

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE:58
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE: 100
   b. RIDGE : 360
   c. VALLEY : 550

DRAWING No. 58 (REFER TABLE 58)

No. OF BAYS	: THREE
SPAN	: 18.0 m
SPACING	: 12.0 m
COLUMN HEIGHT	: 6.5 m
SUPPORT CONDITION	: FIXED
FOR ALL WIND AND SEISMIC ZONES	:
MATERIALS:	
CONCRETE	: M 25
STEEL	: Fe 415



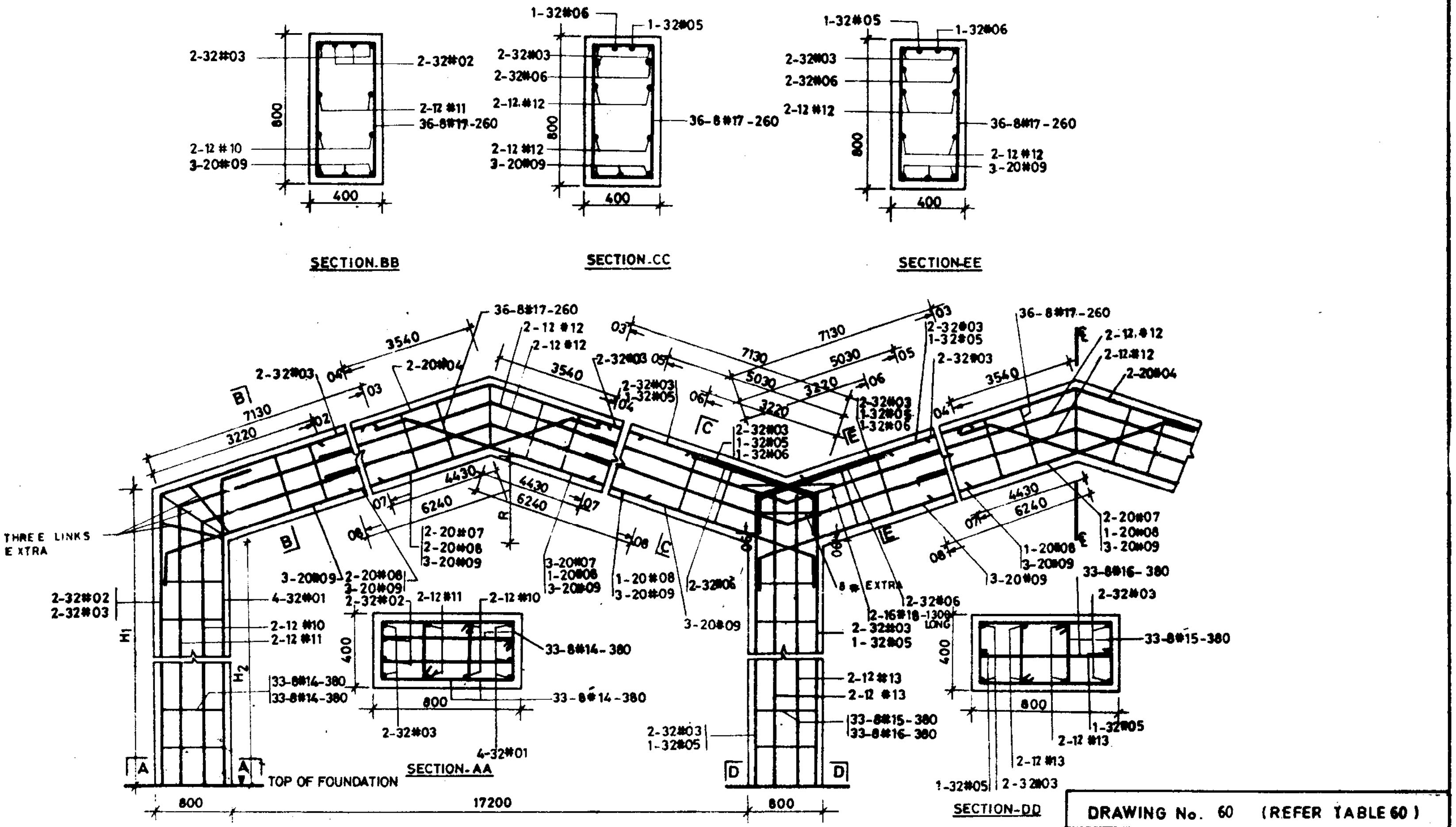
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	9789	9212	2867	8	1350	8	1286
1 in 4	9813	9188	2150	8	1390	8	1254
1 in 5	9828	9172	1720	8	1304	8	1239

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 59
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   - a. EXTERNAL COLUMN FACE : 100
   - b. RIDGE : 360
   - c. VALLEY : 550

DRAWING No. 59 (REFER TABLE 59)

No. OF BAYS	: THREE
SPAN	: 18.0 m
SPACING	: 12.0 m
COLUMN HEIGHT	: 9.5 m
SUPPORT CONDITION	: FIXED
FOR ALL WIND AND SEISMIC ZONES	
MATERIALS:	
CONCRETE	: M 25
STEEL	: Fe 415



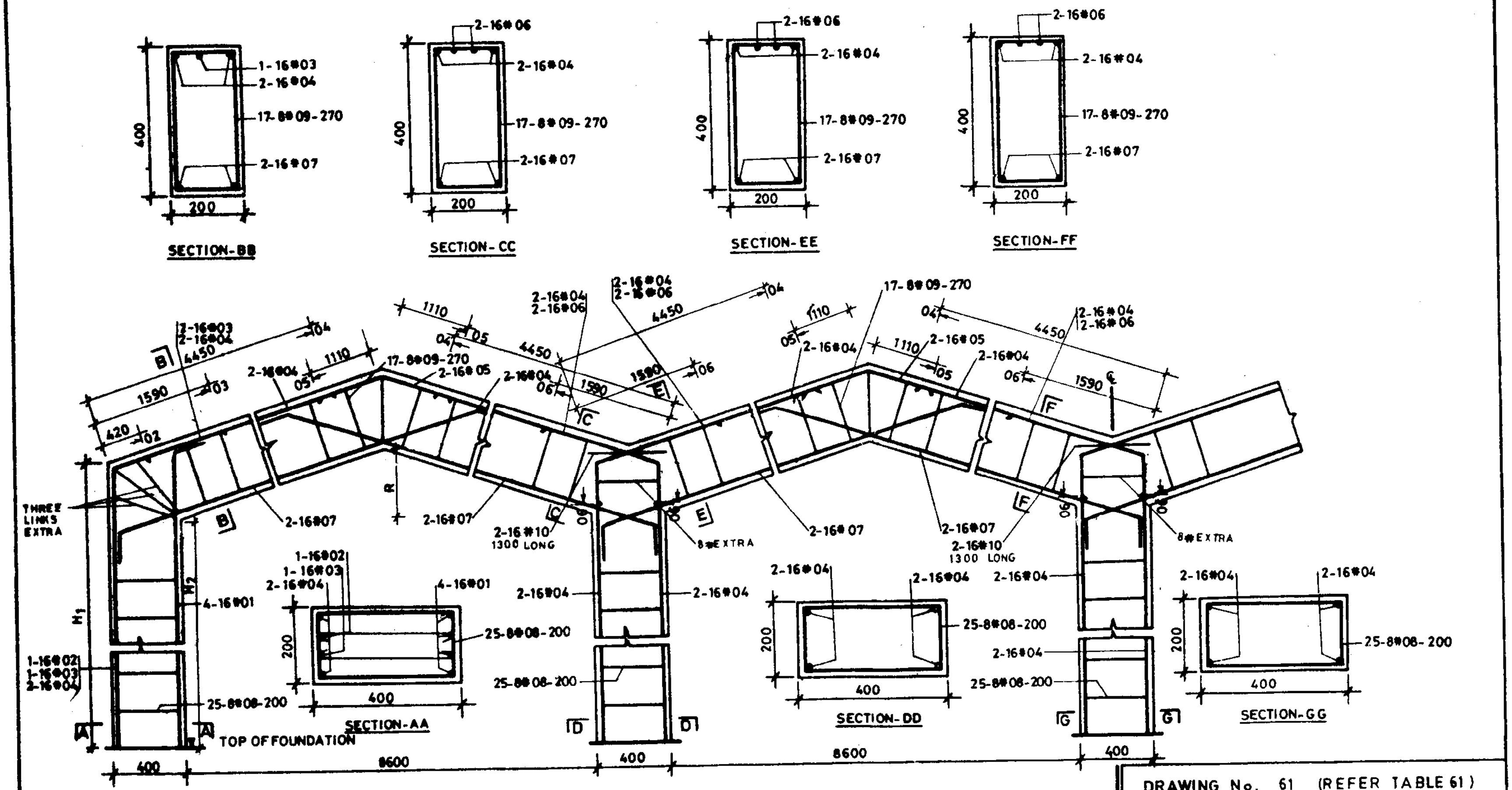
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	12789	12212	2867	8	1350	8	1286
1 in 4	12813	12188	2150	8	1319	8	1254
1 5	12828	12172	1720	8	1304	8	1239

NOTE:

1. ALL DIMENSIONS ARE IN mm.
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 60
3. DISTANCE OF THE NEAREST PURLIN LUG(℄) FROM THE a. EXTARNAL COLUMN FACE : 100
   b. RIDGE : 360
   c. VALLEY : 550

DRAWING No. 60 (REFER TABLE 60)

No. OF BAYS	: THREE
SPAN	: 18.0 m
SPACING	: 12.0 m
COLUMN HEIGHT	: 12.5 m
SUPPORT CONDITION	: FIXED
FOR ALL WIND AND SEISMIC ZONES	:
MATERIALS:	
CONCRETE	: M 25
STEEL	: Fe 415



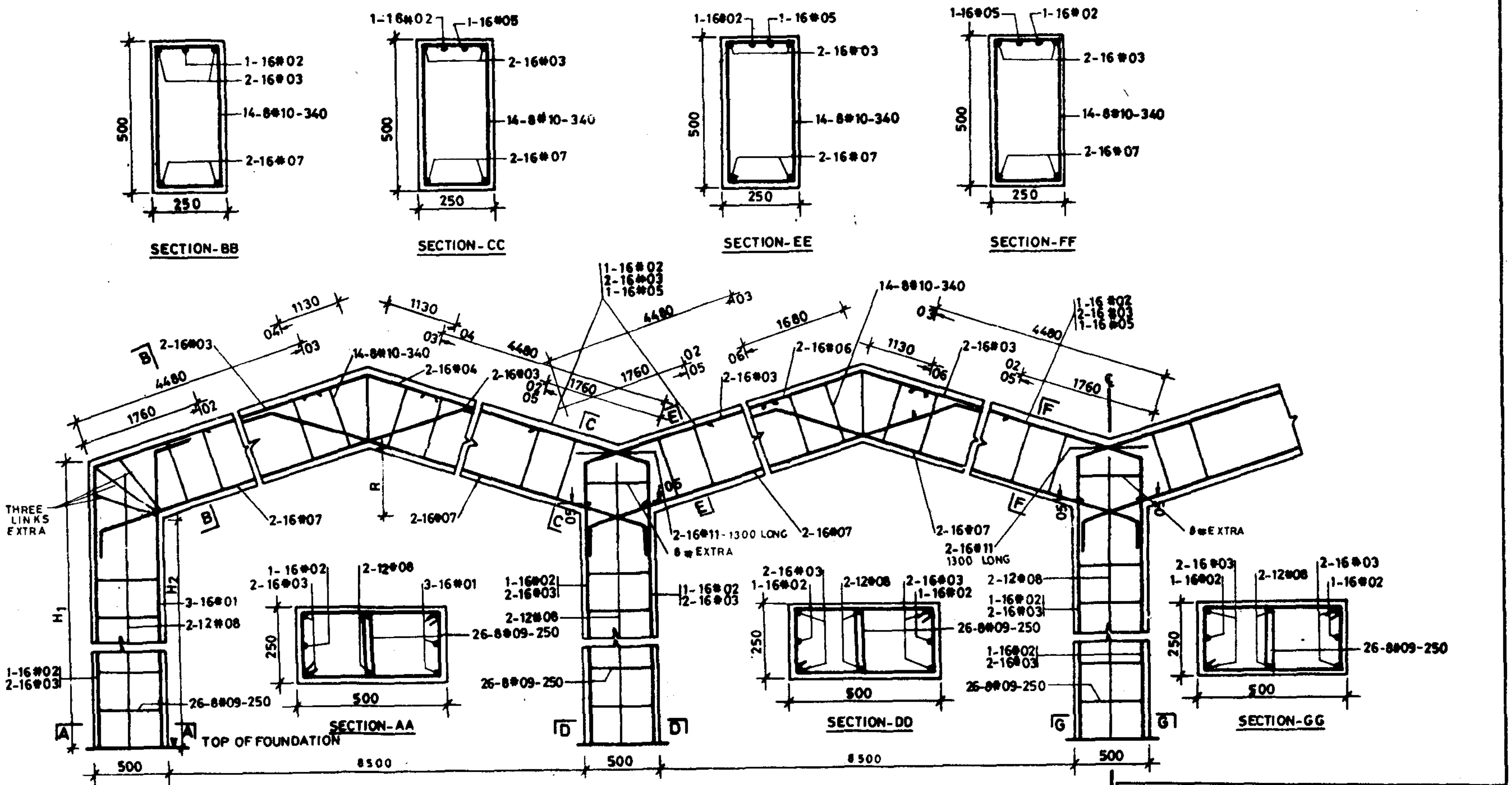
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	5144	4856	1433	5	1139	4	1381
1 in 4	5156	4844	1075	5	1111	4	1346
1 in 5	5164	4836	860	5	1098	4	1330

NOTE :

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 61
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   - a. EXTERNAL COLUMN FACE : 100
   - b. RIDGE : 300
   - c. VALLEY 300

DRAWING No. 61 (REFER TABLE 61)

No. OF BAYS : FOUR
SPAN : 9.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 5.0 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415



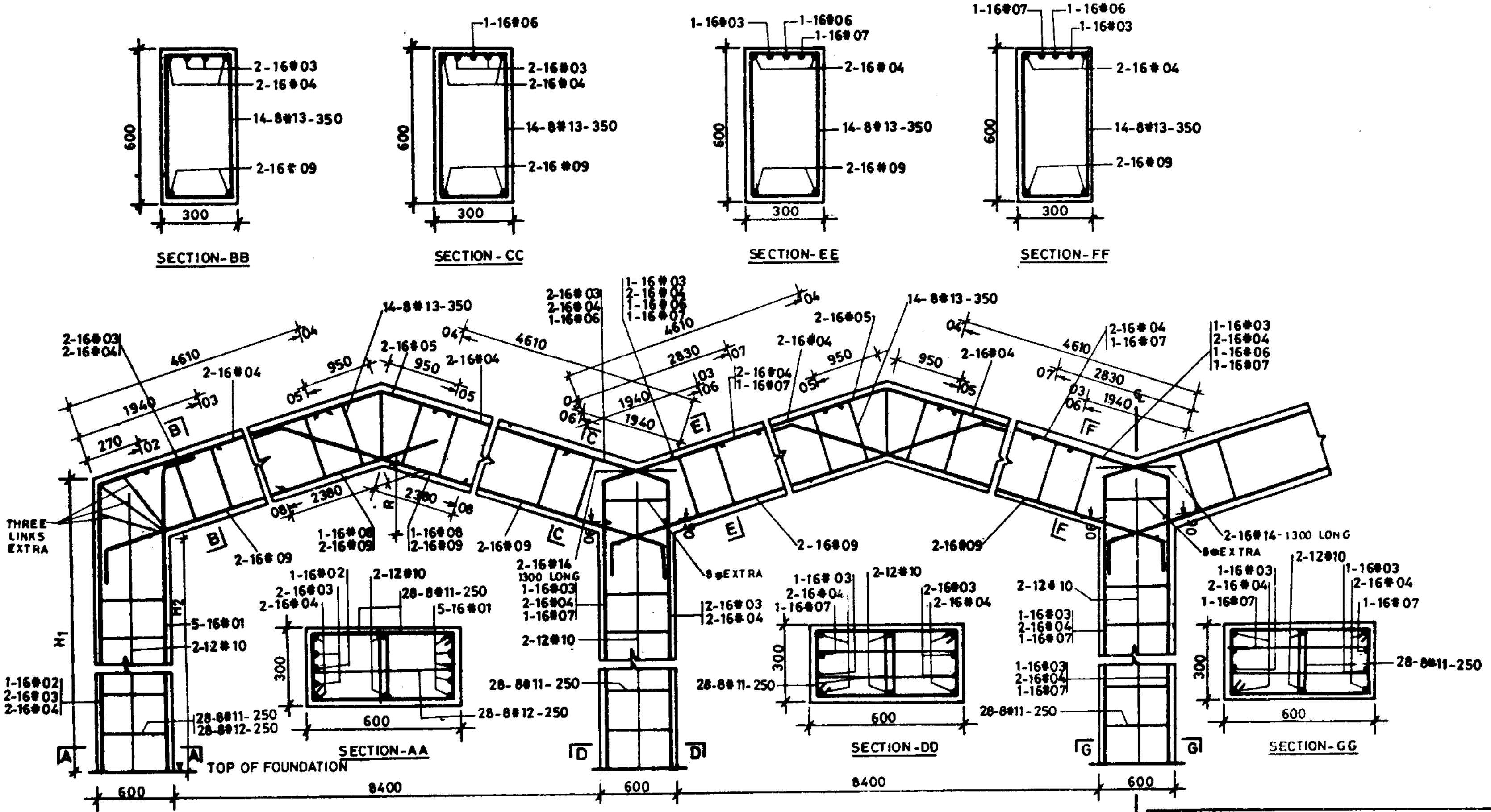
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	6680	6320	1417	5	1151	4	1381
1 in 4	6695	6305	1063	5	1124	4	1346
1 in 5	6705	6295	850	5	1111	4	1330

NOTE :

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 62
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300
   c. VALLEY : 300

DRAWING No. 62 (REFER TABLE 62)

No. OF BAYS : FOUR
SPAN : 9.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 6.5 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415



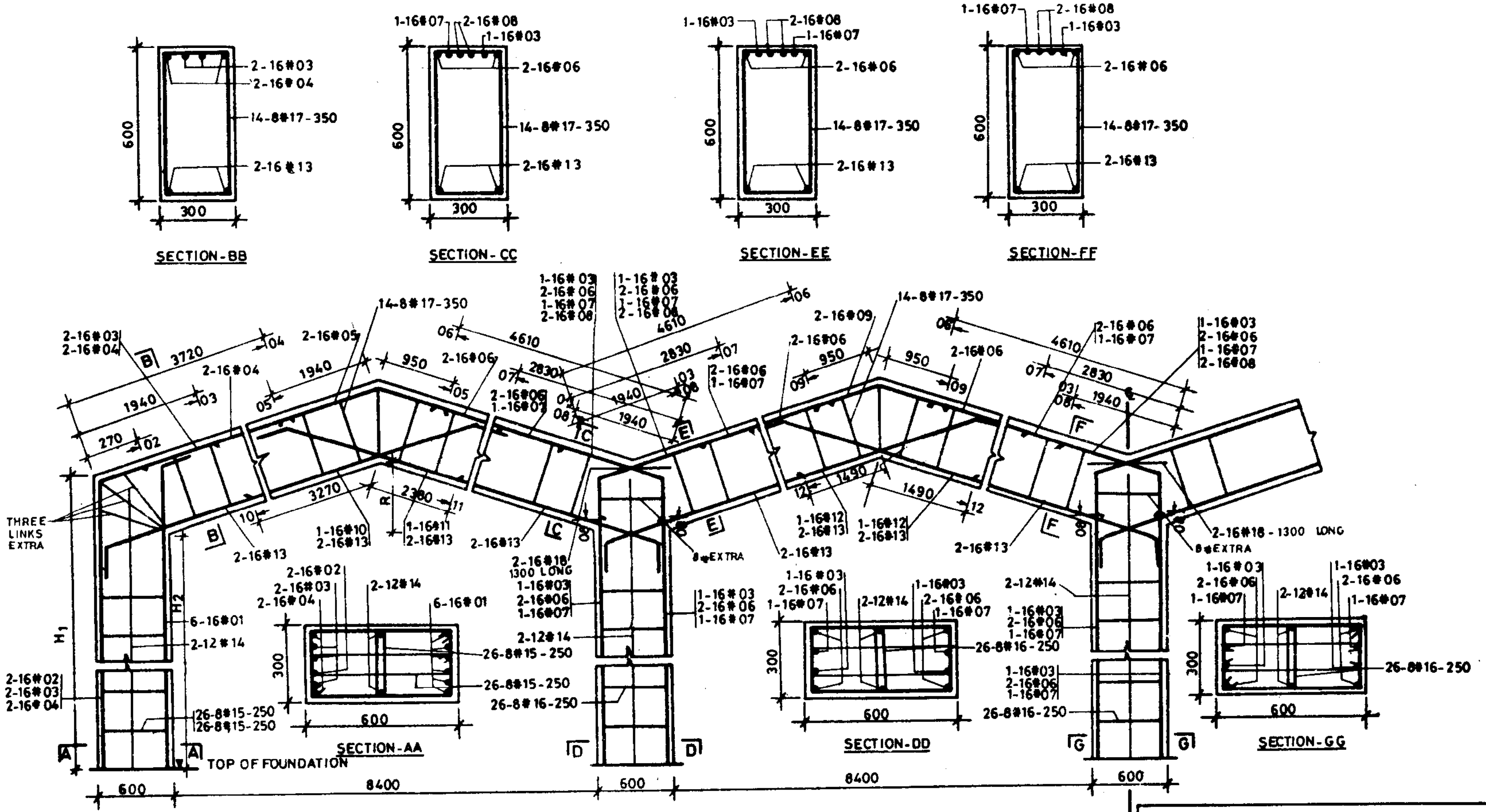
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	5217	4784	1400	5	1150	4	1361
1 in 4	5234	4766	1050	5	1122	4	1326
1 5	5246	4754	840	5	1109	4	1310

NOTE :

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 63
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360
   c. VALLEY : 300

DRAWING No. 63 (REFER TABLE 63)

No. OF BAYS	: FOUR
SPAN	: 9.0 m
SPACING	: 12.0 m
COLUMN HEIGHT	: 5.0 m
SUPPORT CONDITION	: FIXED
FOR ALL WIND AND SEISMIC ZONES	
MATERIALS:	
CONCRETE	: M 25
STEEL	: Fe415



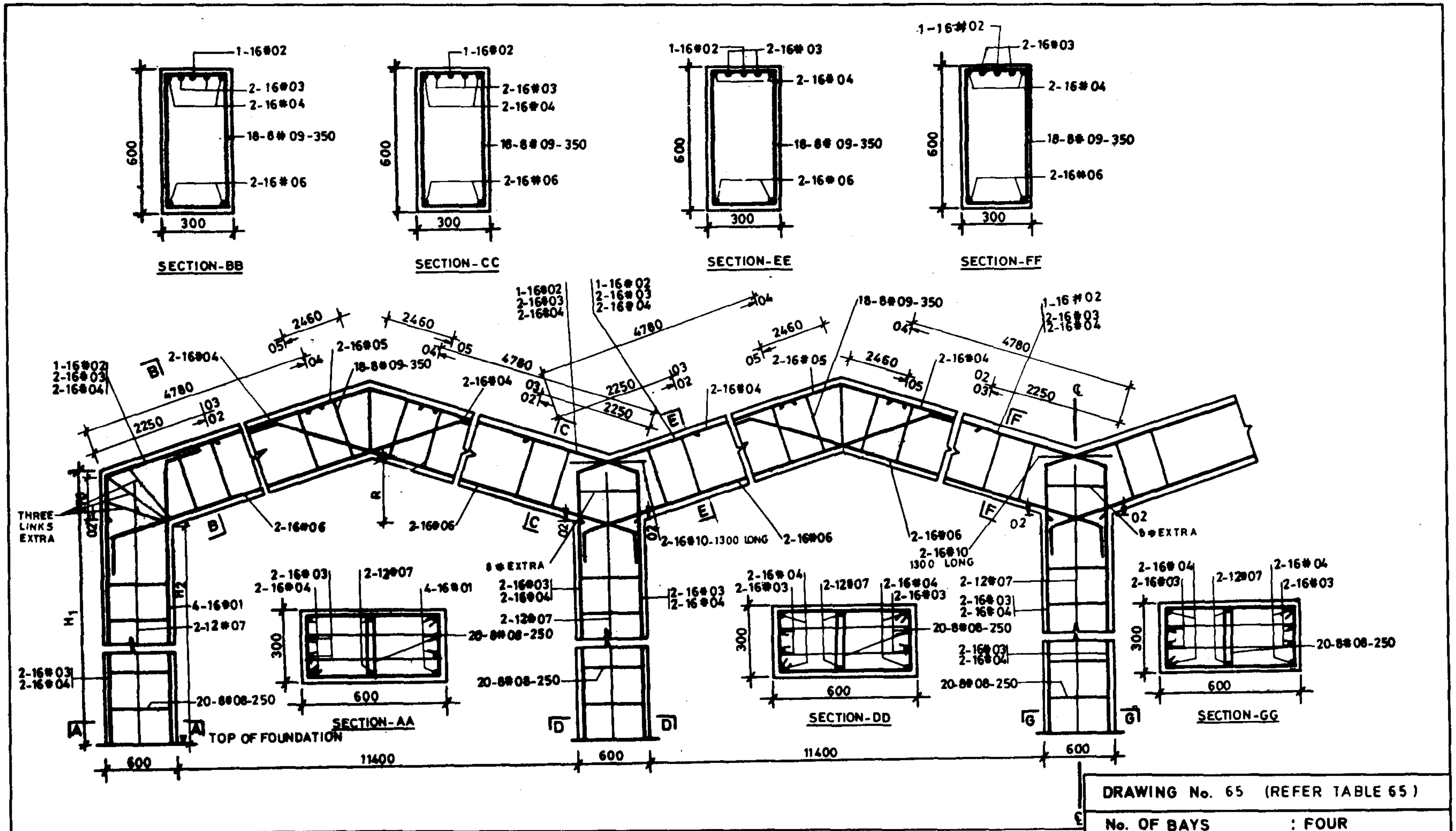
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	6717	6284	1400	5	1150	4	1361
1 in 4	6734	6266	1050	5	1122	4	1326
1 in 5	6746	6254	840	5	1109	4	1310

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 64
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360
   c. VALLEY : 300

DRAWING No. 64 (REFER TABLE 64)

No. OF BAYS	: FOUR
SPAN	: 9.0 m
SPACING	: 12.0 m
COLUMN HEIGHT	: 6.5 m
SUPPORT CONDITION	: FIXED
FOR ALL WIND AND SEISMIC ZONES	
MATERIALS:	
CONCRETE	: M 25
STEEL	: Fe 415



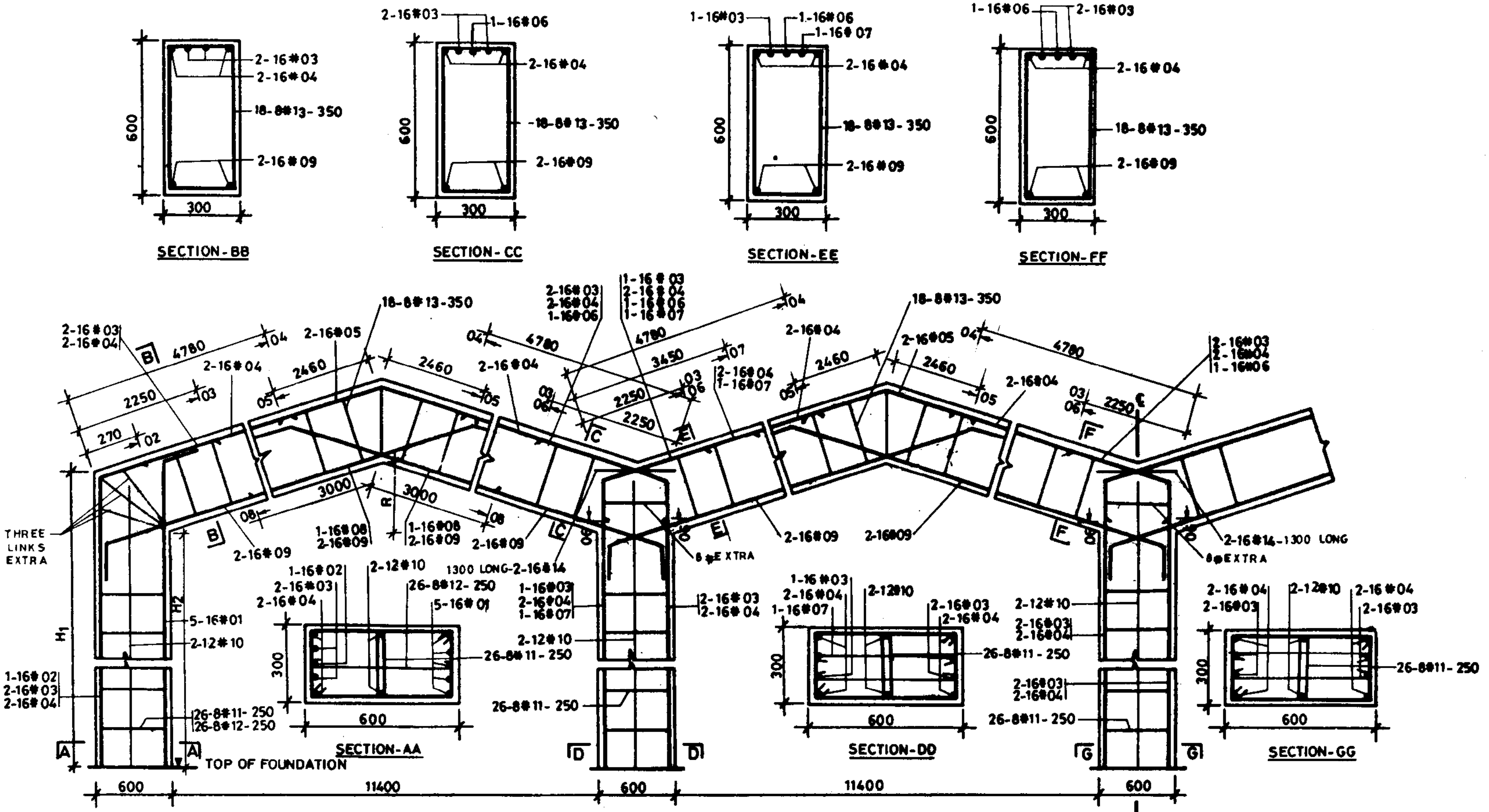
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	5217	4784	1900	6	1248	6	1145
1 in 4	5234	4766	1425	6	1219	5	1396
1 in 5	5246	4754	1140	6	1205	5	1380

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 65
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300
   c. VALLEY : 300

DRAWING No. 65 (REFER TABLE 65)

No. OF BAYS	: FOUR
SPAN	: 12.0 m
SPACING	: 6.0 m
COLUMN HEIGHT	: 5.0 m
SUPPORT CONDITION	: FIXED
FOR ALL WIND AND SEISMIC ZONES	
MATERIALS :	
CONCRETE	: M 25
STEEL	: Fe 415



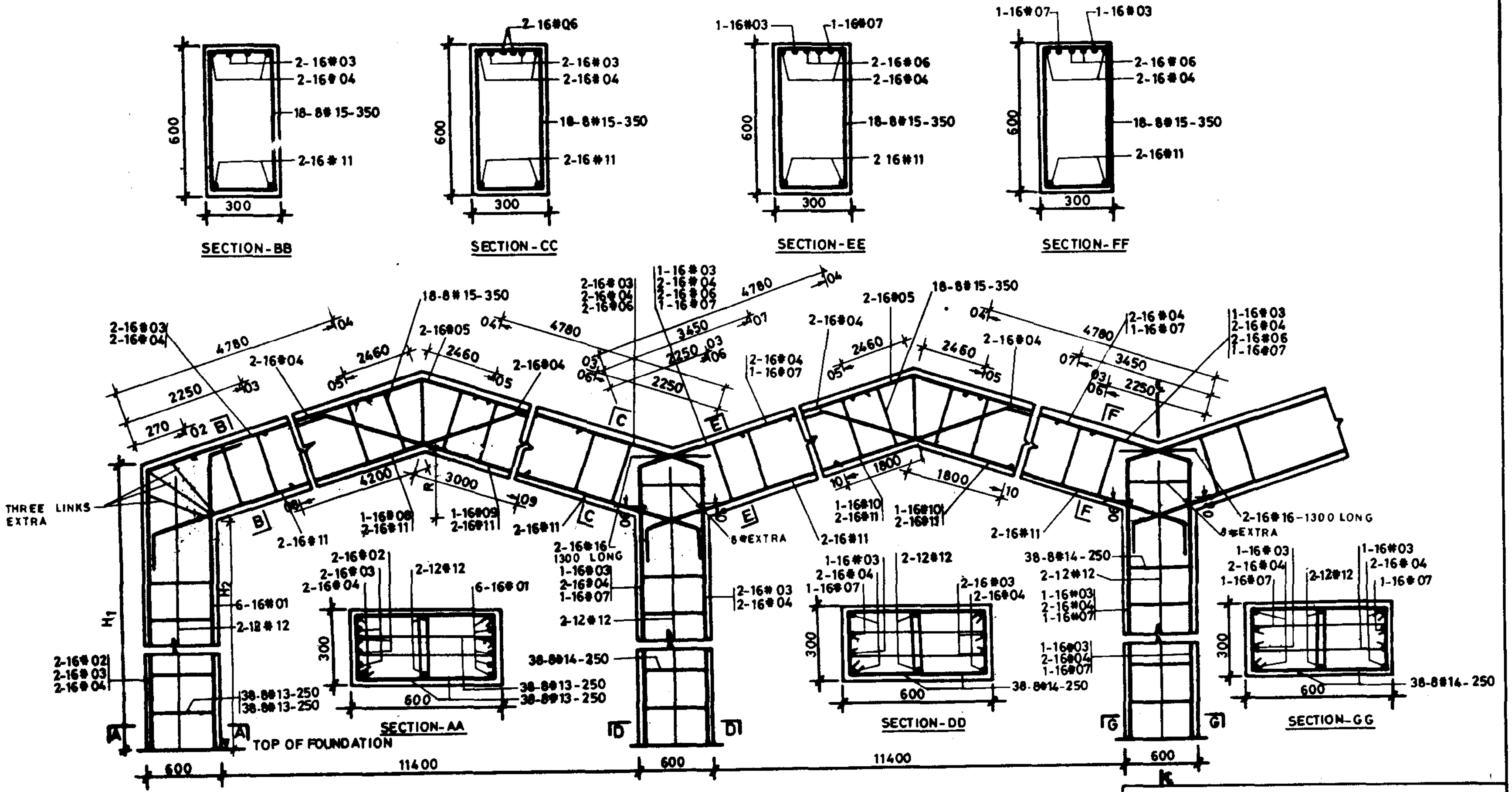
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	6717	6284	1900	6	1248	6	1145
1 in 4	6734	6266	1425	6	1219	5	1396
1 in 5	6746	6254	1140	6	1205	5	1380

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 66
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   - a. EXTERNAL COLUMN FACE : 100
   - b. RIDGE : 300
   - c. VALLEY : 300

DRAWING No. 66 (REFER TABLE 66)

No. OF BAYS : FOUR
SPAN : 12.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 6.5 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415



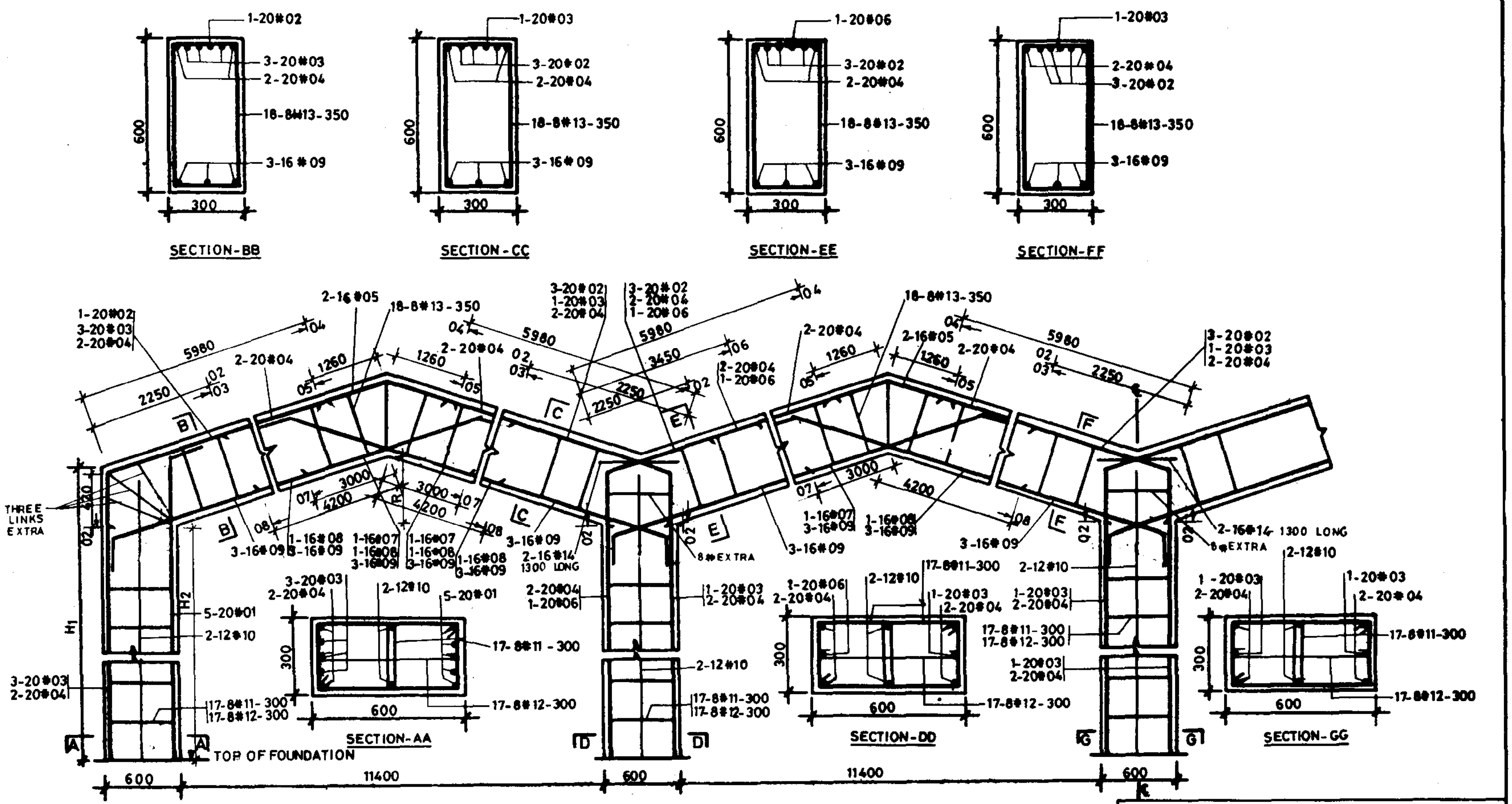
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	9717	9284	1900	6	1248	6	1145
1 in 4	9734	9266	1425	6	1219	5	1396
1 in 5	9746	9254	1140	6	1205	5	1380

NOTE :

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 67
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300
   c. VALLEY : 300

DRAWING No. 67 (REFER TABLE 67)

No. OF BAYS : FOUR
SPAN : 12.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 9.5 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415



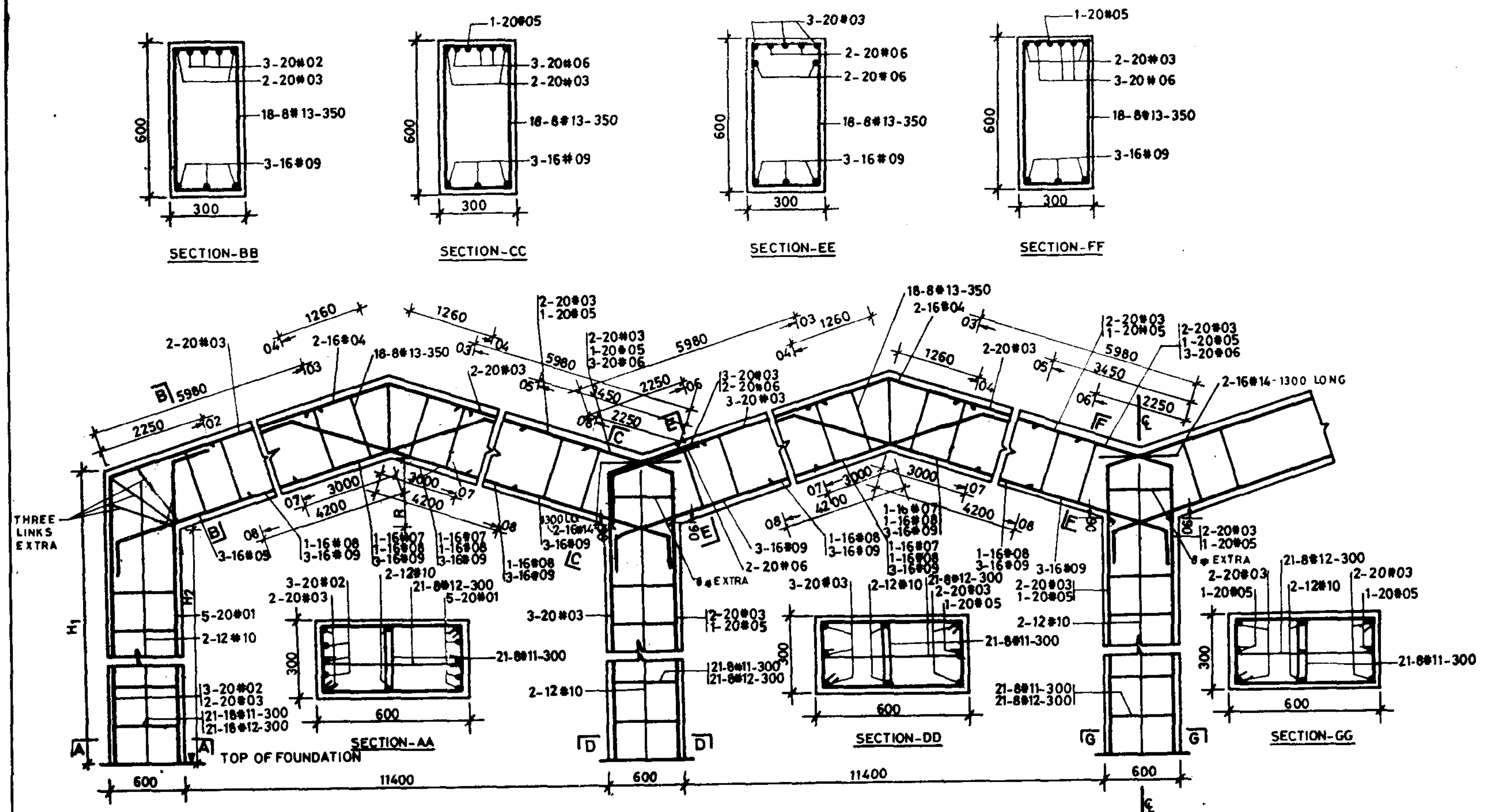
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	5217	4784	1900	6	1236	6	1133
1 in 4	5234	4766	1425	6	1207	5	1381
1 in 5	5246	4754	1140	6	1193	5	1365

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE: 68
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360
   c. VALLEY : 300

DRAWING No. 68 (REFER TABLE 68)

No. OF BAYS : FOUR
SPAN : 12.0m
SPACING : 12.0m
COLUMN HEIGHT : 5.0m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415



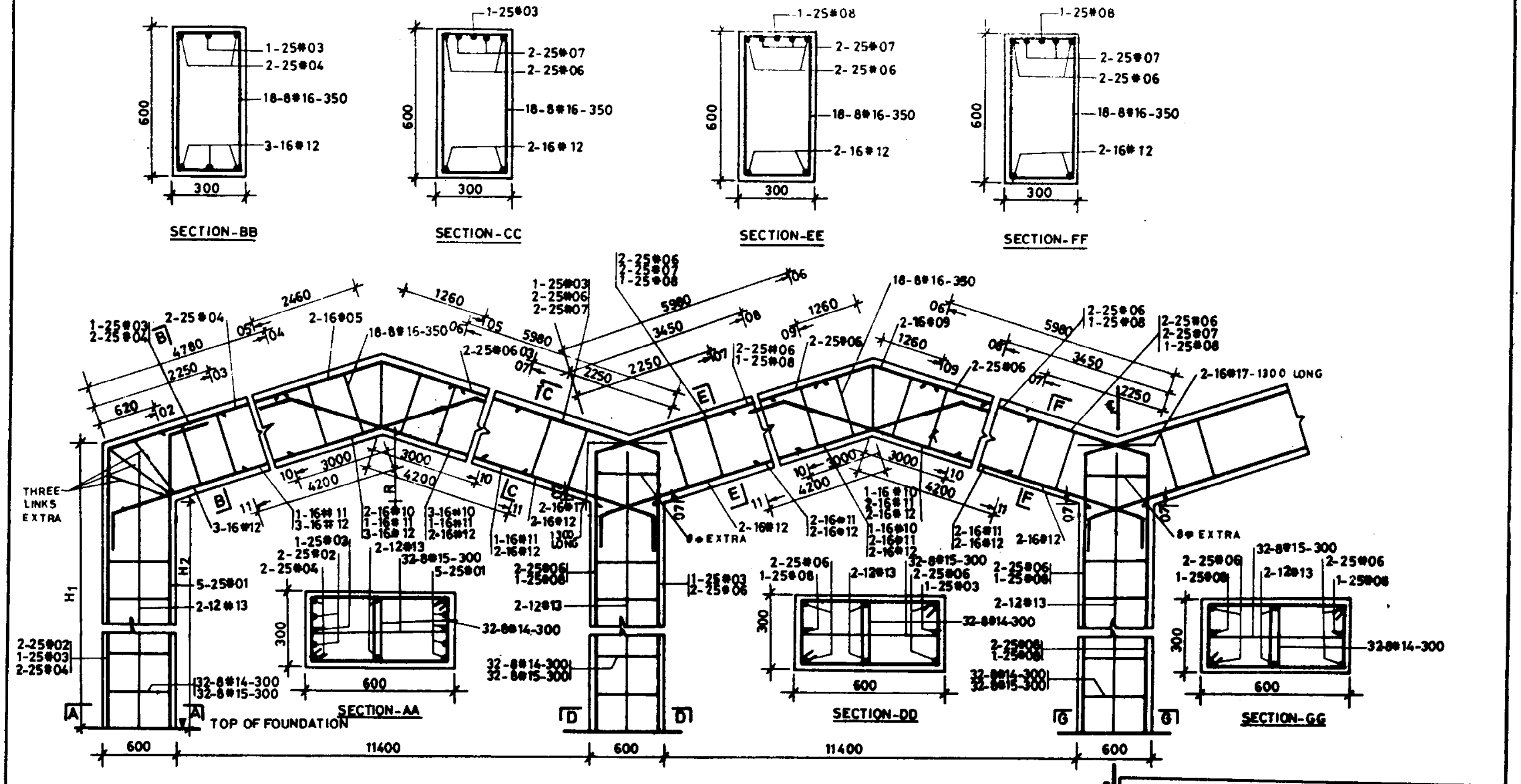
SLOPE	H1	H2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	6717	6284	1900	6	1236	6	1133
1 in 4	6734	6266	1425	6	1207	5	1381
1 in 5	6746	6254	1140	6	1193	5	1365

NOTE :

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 69
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360
   c. VALLEY : 300

DRAWING No. 69 (REFER TABLE 69)

No. OF BAYS : FOUR
SPAN : 12.0 m
SPACING : 12.0 m
COLUMN HEIGHT : 6.5 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS:
CONCRETE : M 25
STEEL : Fe 415



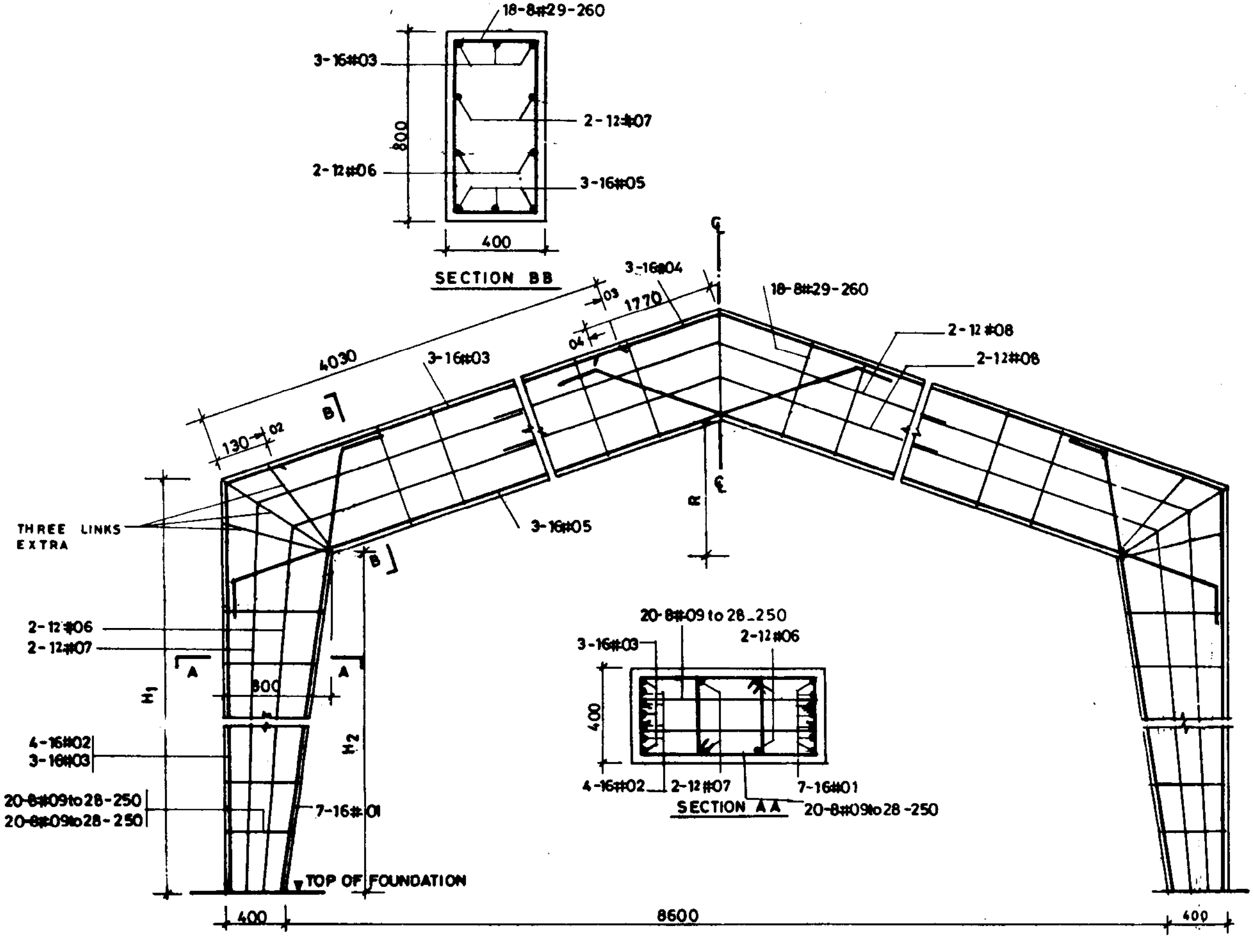
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	9717	9284	1900	6	1236	6	1133
1 in 4	9734	9266	1425	6	1207	5	1381
1 in 5	9746	9254	1140	6	1193	5	1365

NOTE :

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE : 70
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360
   c. VALLEY : 300

DRAWING No. 70 (REFER TABLE 70)

No. OF BAYS : FOUR
SPAN : 12.0 m
SPACING : 12.0 m
COLUMN HEIGHT : 9.5 m
SUPPORT CONDITION : FIXED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS :
CONCRETE : M 25
STEEL : Fe 415



SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS	
				PRINCIPAL RAFTER	
				No. OF PURLINS	SPACING
1 in 3	5280	4712	1367	5	1198
1 in 4	5306	4688	1025	5	1170
1 in 5	5322	4672	820	5	1156

NOTE

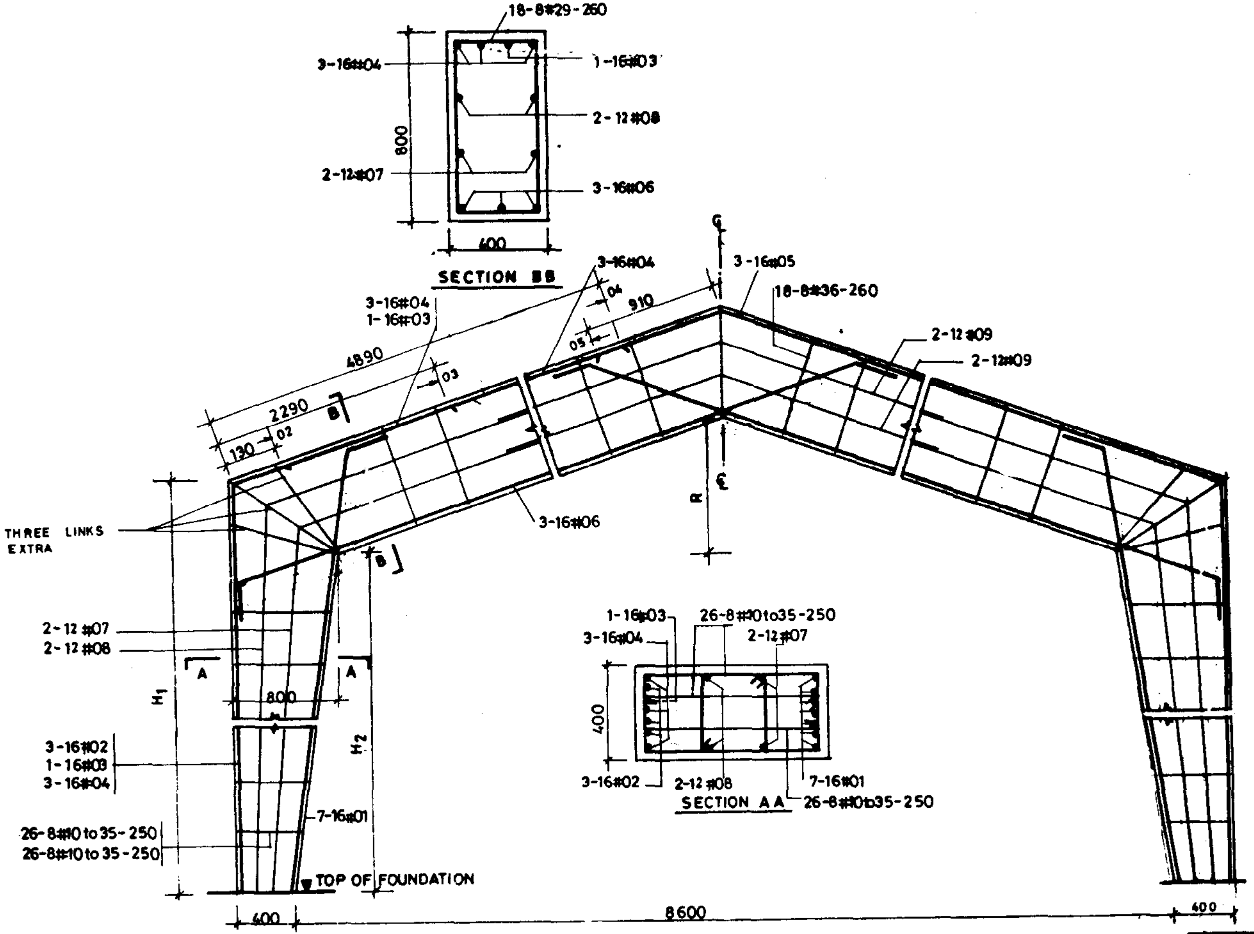
1 ALL DIMENSIONS ARE IN mm

2 FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE: 71

3 DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
a. EXTERNAL COLUMN FACE : 100
b. RIDGE : 300

DRAWING No. 71 (REFER TABLE 71)

No. OF BAYS	: ONE
SPAN	: 9.0 m
SPACING	: 6.0 m
COLUMN HEIGHT	: 5.0 m
SUPPORT CONDITION	: HINGED
FOR ALL WIND AND SEISMIC ZONES	
MATERIALS :	
CONCRETE	: M 25
STEEL	: Fe 415



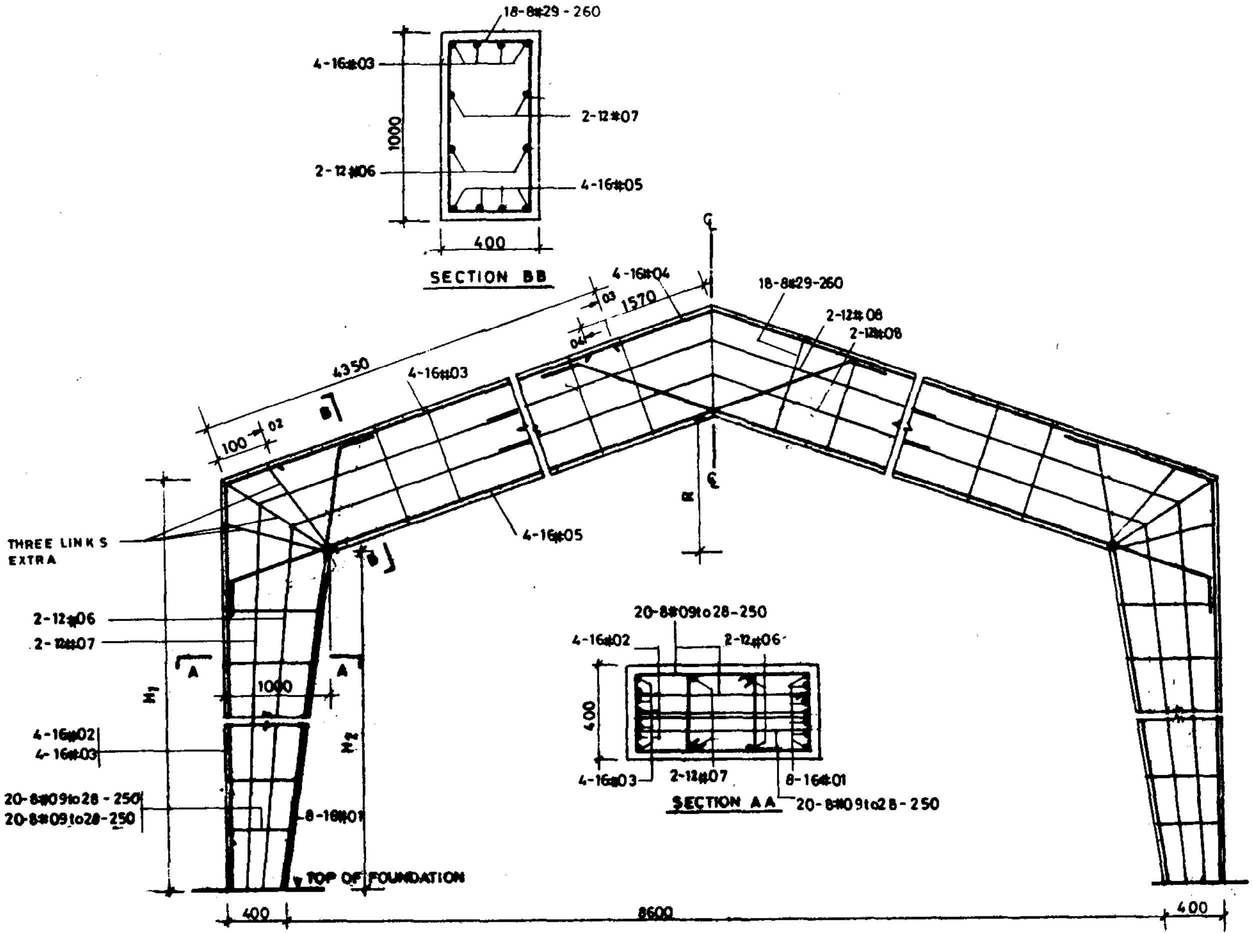
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS PRINCIPAL RAFTER No. OF PURLINS	SPACING
1 in 3	6782	6212	1367	5	1197
1 in 4	6807	6188	1025	5	1168
1 in 5	6824	6172	820	5	1155

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE .72
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300

DRAWING No. 72 (REFER TABLE 72)

No. OF BAYS : ONE
SPAN : 9.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 6.5 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS
CONCRETE : M 25
STEEL : Fe 415



SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS	
				PRINCIPAL RAFTER	
				No. OF PURLINS	SPACING
1 in 3	5345	4640	1333	5	1215
1 in 4	5378	4610	1000	5	1186
1 in 5	5399	4590	800	5	1173

NOTE

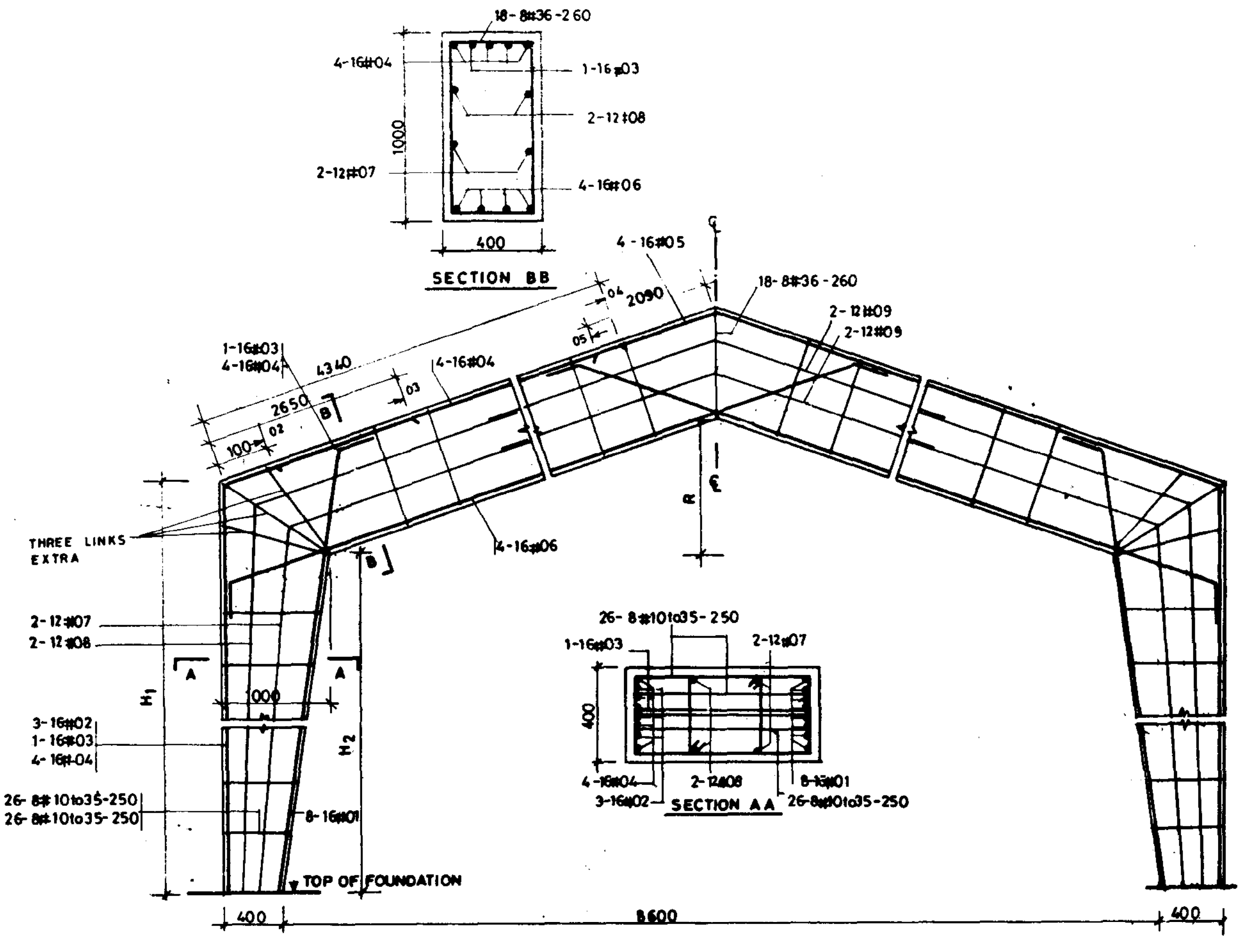
1 ALL DIMENSIONS ARE IN mm

2 FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE _ 73

3 DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
a. EXTERNAL COLUMN FACE : 100
b. RIDGE : 360

DRAWING No. 73 (REFER TABLE 73)

No. OF BAYS : ONE
SPAN : 9.0 m
SPACING : 12.0 m
COLUMN HEIGHT : 5.0 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS
CONCRETE : M 25
STEEL : Fe 415



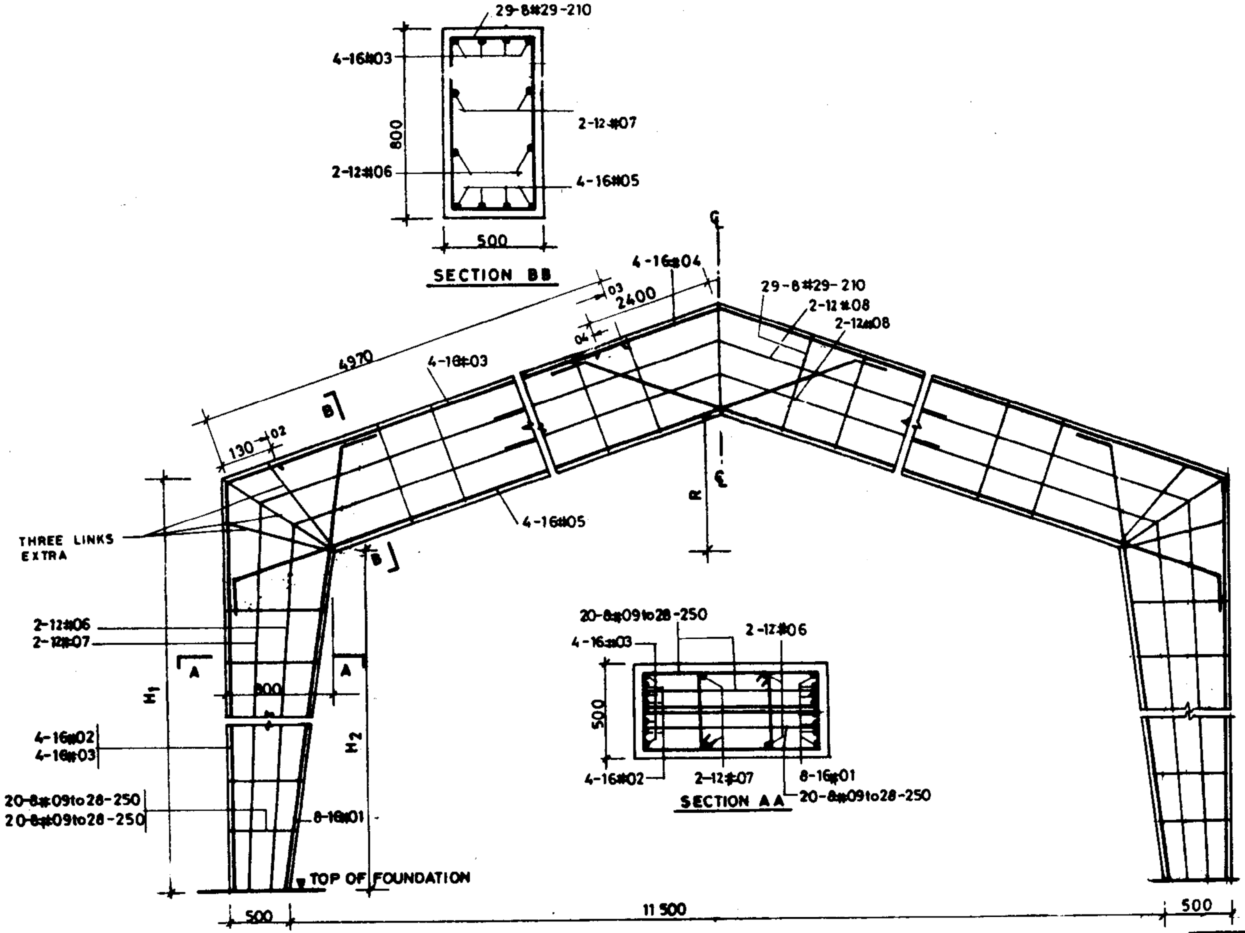
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS PRINCIPAL RAFTER No. OF PURLINS	SPACING
1 in 3	6849	6140	1333	5	1212
1 in 4	6881	6110	1000	5	1183
1 in 5	6902	6090	800	5	1170

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE-74
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
    a. EXTERNAL COLUMN FACE : 100
    b. RIDGE : 360

DRAWING No. 74 (REFER TABLE 74)

No. OF BAYS	: ONE
SPAN	: 9.0 m
SPACING	: 12.0 m
COLUMN HEIGHT	: 6.5 m
SUPPORT CONDITION	: HINGED
FOR ALL WIND AND SEISMIC ZONES	
MATERIALS :	
CONCRETE	: M25
STEEL	: Fe 415



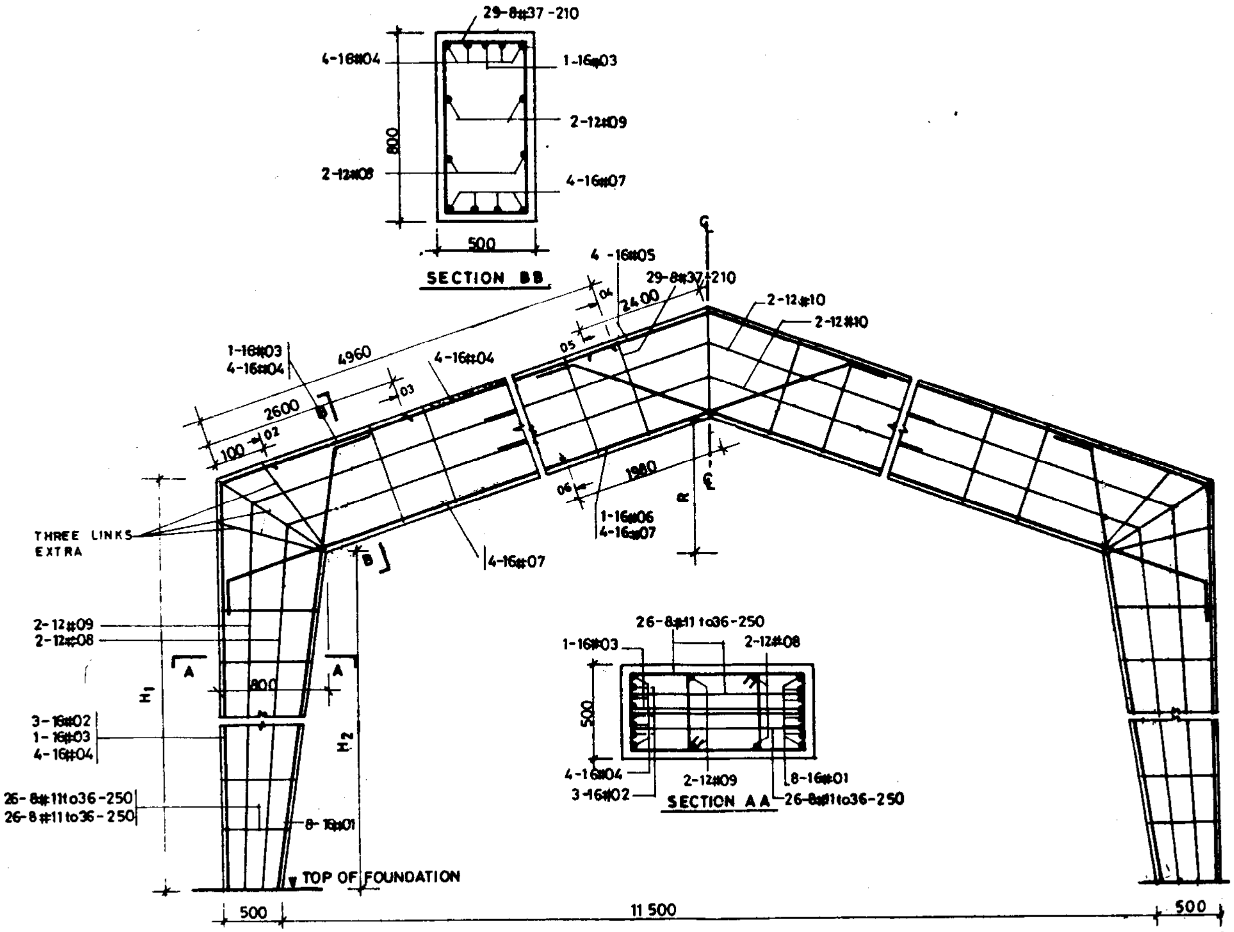
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS PRINCIPAL RAFTER No. OF PURLINS	No. AND SPACING OF PURLINS PRINCIPAL RAFTER SPACING
1 in 3	5282	4712	1867	6	1273
1 in 4	5307	4688	1400	6	1243
1 in 5	5324	4672	1120	6	1230

NOTE

1 ALL DIMENSIONS ARE IN mm
2 FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE – 75
3 DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE : 100
b. RIDGE : 300

DRAWING No. 75 (REFER TABLE 75)

No. OF BAYS	: ONE
SPAN	: 12.0 m
SPACING	: 6.0 m
COLUMN HEIGHT	: 5.0 m
SUPPORT CONDITION	: HINGED
FOR ALL WIND AND SEISMIC ZONES	
MATERIALS	
CONCRETE	: M 25
STEEL	: Fe 415



SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS PRINCIPAL RAFTER No. OF PURLINS	No. AND SPACING OF PURLINS PRINCIPAL RAFTER SPACING
1 in 3	6784	6212	1867	6	1272
1 in 4	6809	6188	1400	6	1243
1 in 5	6825	6172	1120	6	1229

NOTE

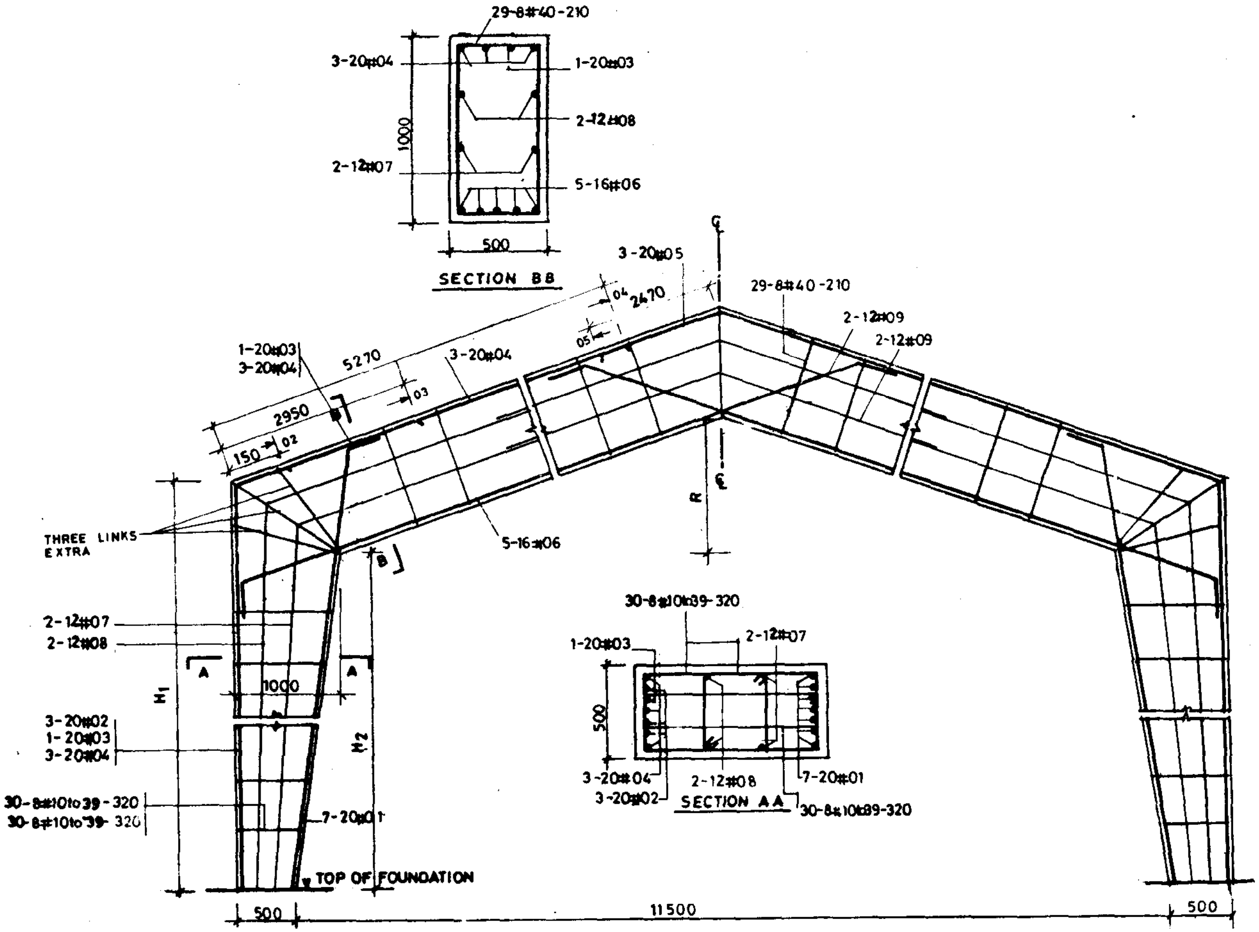
1 ALL DIMENSIONS ARE IN mm

2 FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE-76

3 DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE : 100
b. RIDGE : 300

DRAWING No. 76 (REFER TABLE 76)

No. OF BAYS	: ONE
SPAN	: 12.0 m
SPACING	: 6.0 m
COLUMN HEIGHT	: 6.5 m
SUPPORT CONDITION	: HINGED
FOR ALL WIND AND SEISMIC ZONES	
MATERIALS	
CONCRETE	: M 25
STEEL	: Fe 415



SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS	
				PRINCIPAL RAFTER	
				No. OF PURLINS	SPACING
1 in 3	9854	9140	1833	6	1295
1 in 4	9885	9110	1375	6	1264
1 in 5	9906	9090	1100	6	1250

NOTE

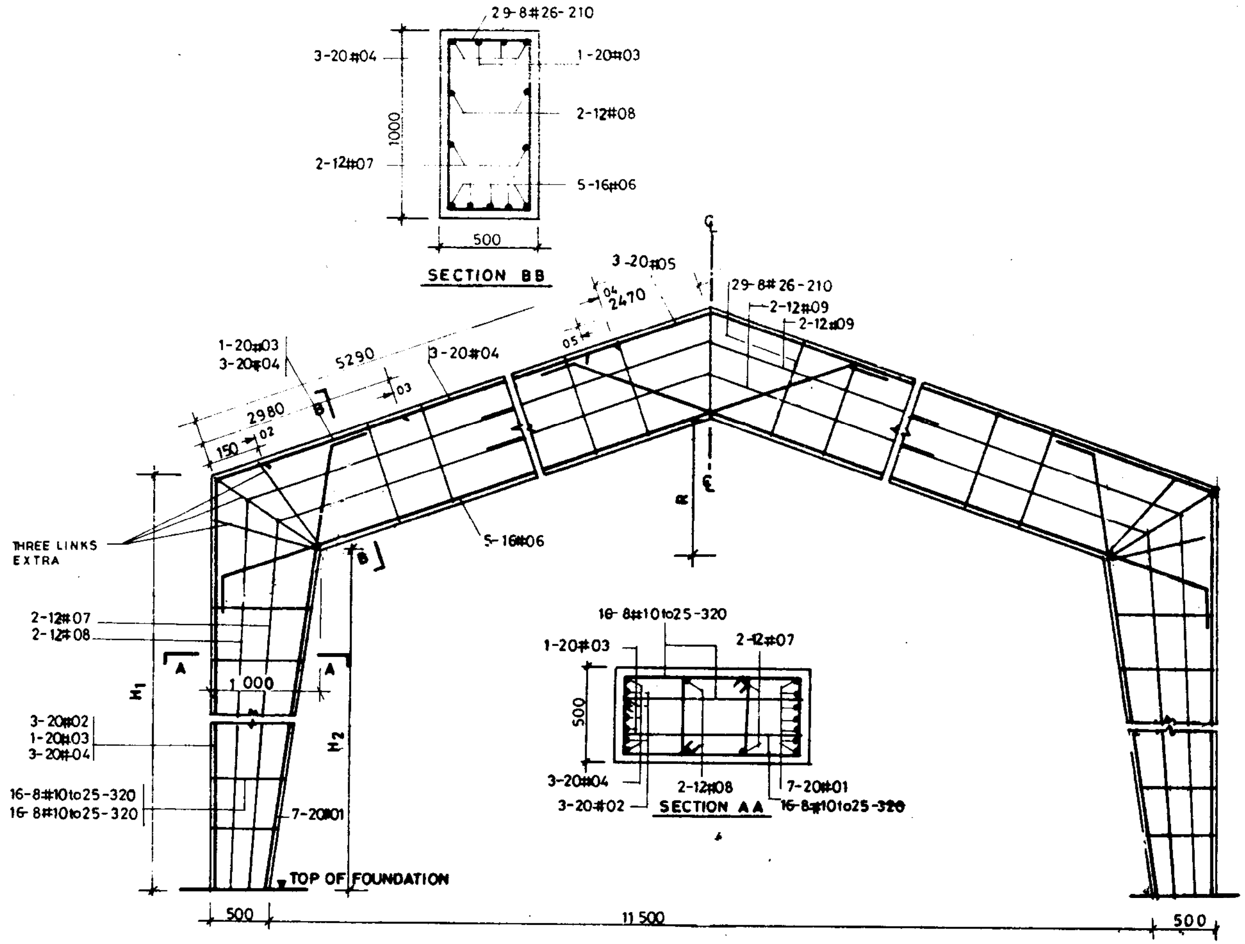
1 ALL DIMENSIONS ARE IN mm

2 FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE -77

3 DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE : 100
b. RIDGE : 300

DRAWING No. 77 (REFER TABLE 77)

No. OF BAYS : ONE
SPAN : 12.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 9.5 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS
CONCRETE : M 25
STEEL : Fe 415



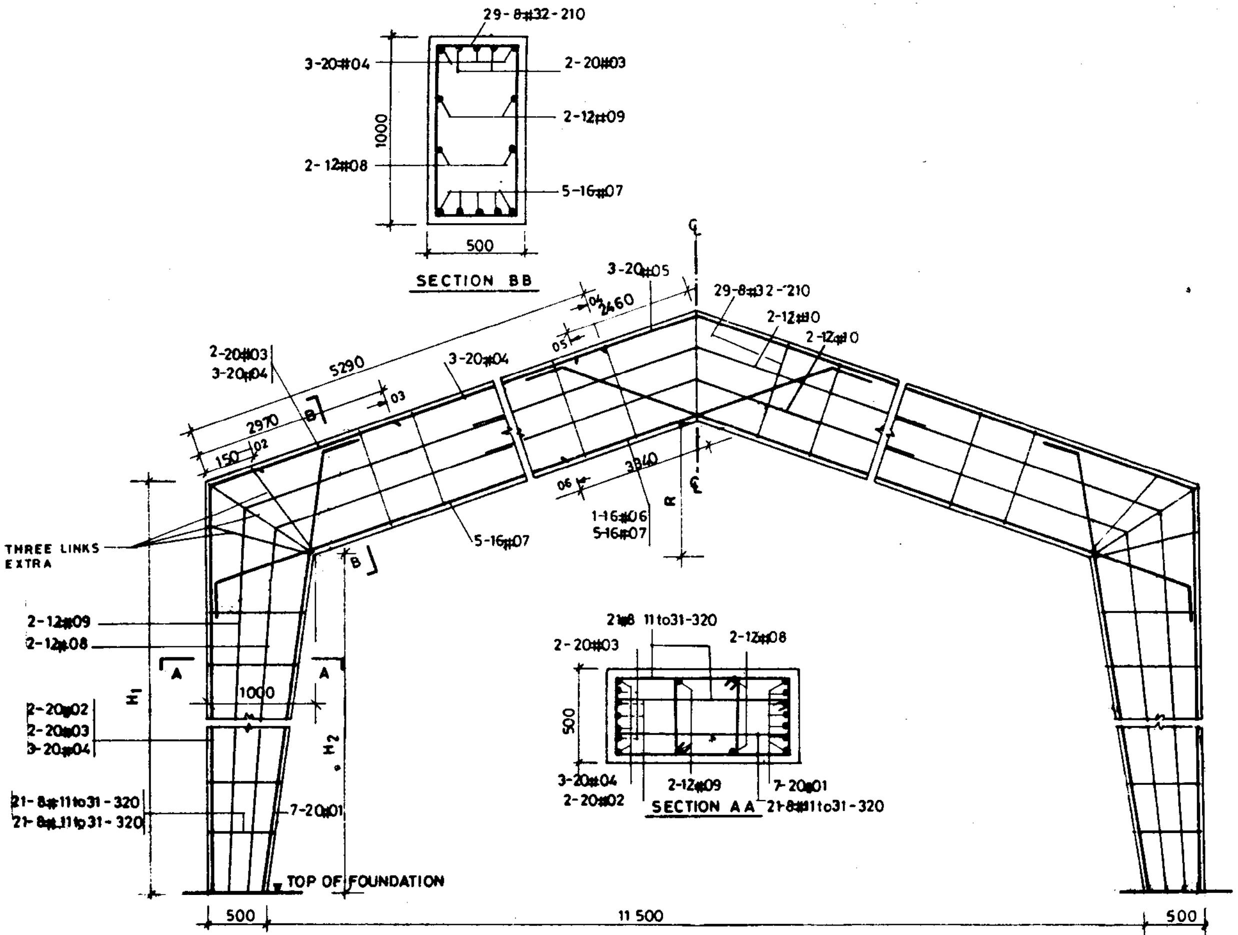
SLOPE	H1	H2	R	No. AND SPACING OF PURLINS PRINCIPAL RAFTER No. OF PURLINS	SPACING
1 in 3	5348	4640	1833	6	1287
1 in 4	5380	4610	1375	6	1257
1 in 5	5402	4590	1100	6	1248

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE. 78
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360

DRAWING No. 78 (REFER TABLE 78)

No. OF BAYS : ONE
SPAN : 12.0 m
SPACING : 12.0 m
COLUMN HEIGHT : 5.0 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS
CONCRETE : M25
STEEL : Fe 415



SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS PRINCIPAL RAFTER No. OF PURLINS	SPACING
1 in 3	6851	6140	1833	6	1285
1 in 4	6883	6110	1375	6	1254
1 in 5	6903	6090	1100	6	1241

NOTE

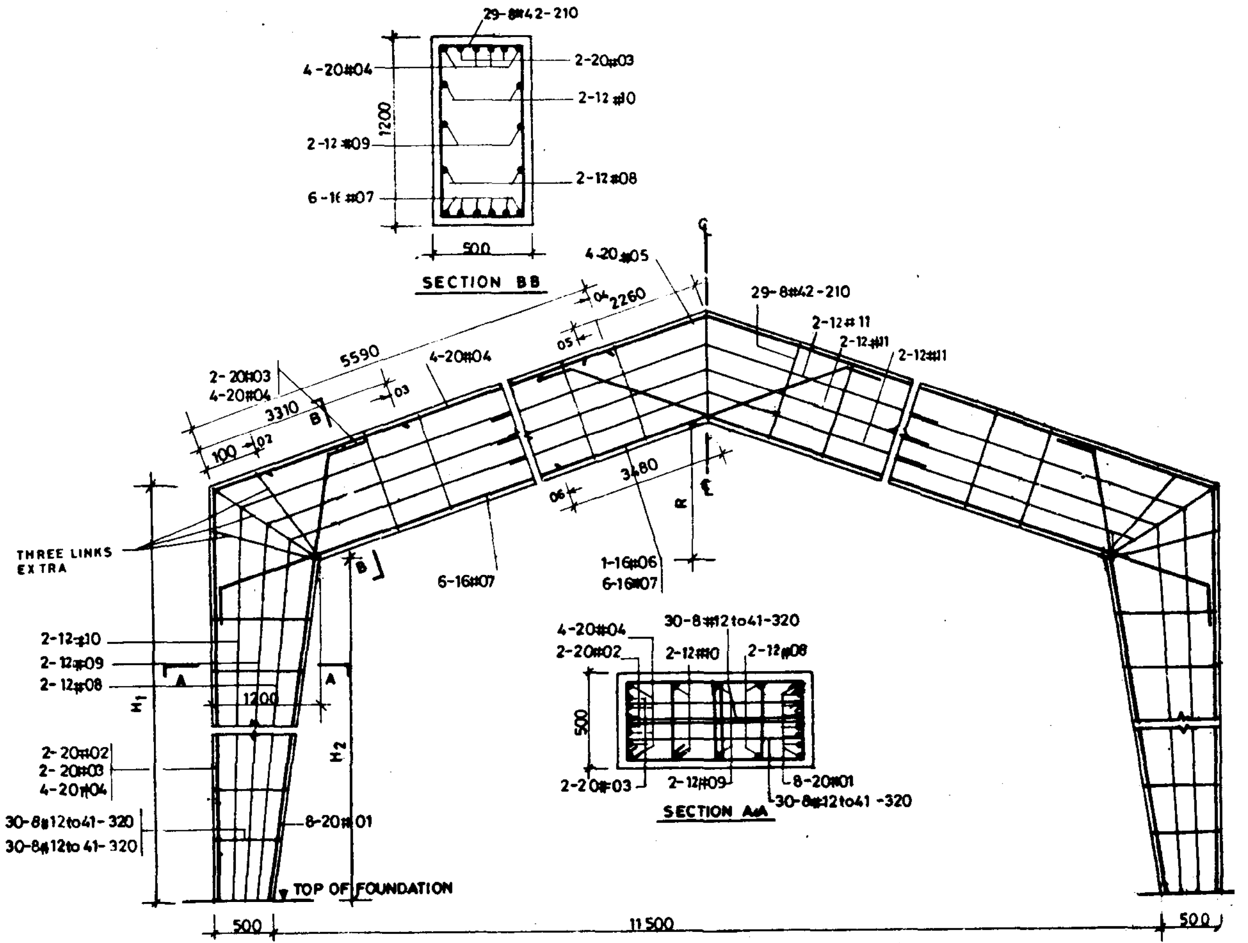
1 ALL DIMENSIONS ARE IN mm

2 FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE-79

3 DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
a. EXTERNAL COLUMN FACE : 100
b. RIDGE : 360

DRAWING No. 79 (REFER TABLE 79)

No. OF BAYS : ONE
SPAN : 12.0 m
SPACING : 12.0 m
COLUMN HEIGHT : 6.5 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS
CONCRETE : M 25
STEEL : Fe416



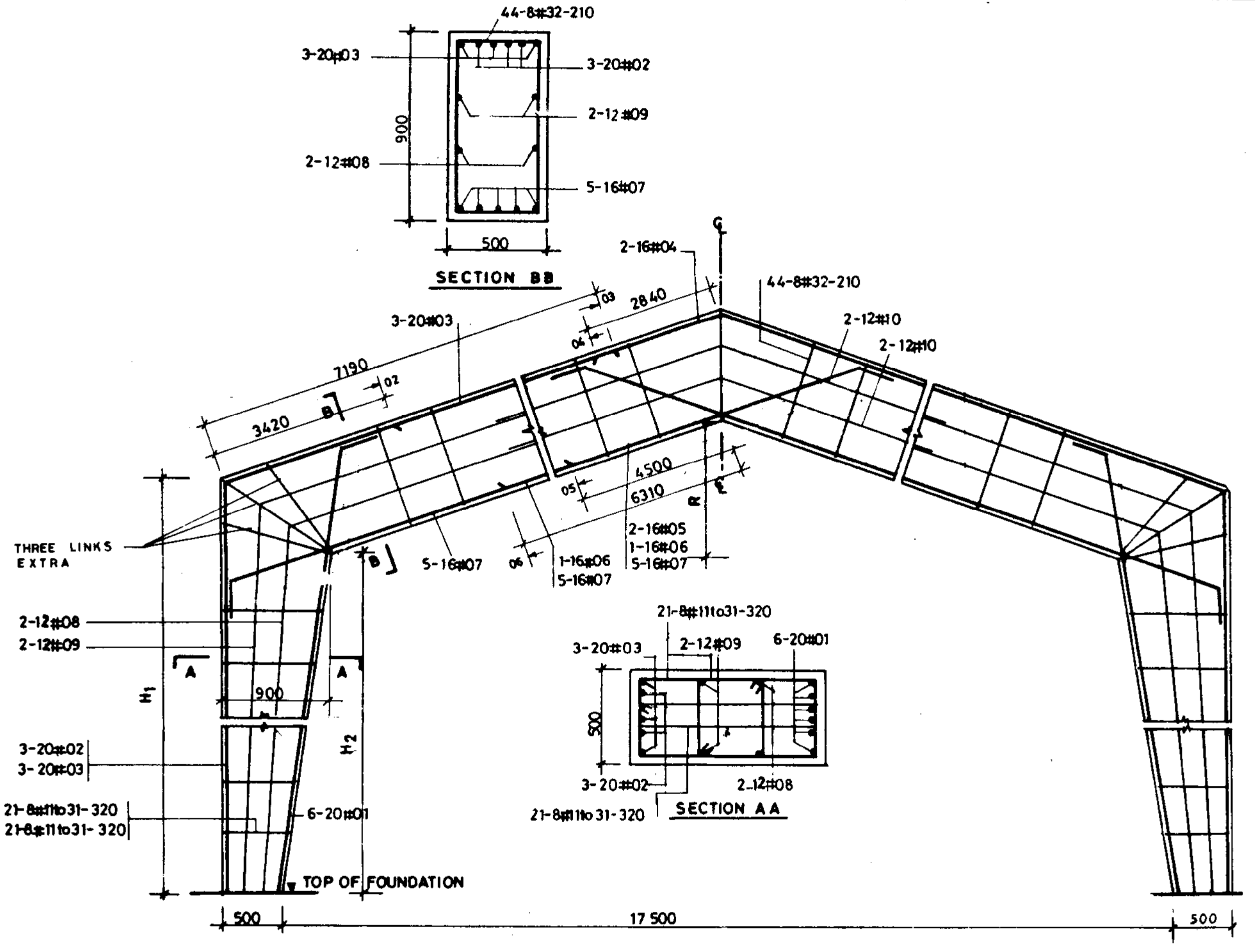
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS PRINCIPAL RAFTER No. OF PURLINS	 SPACING
1 in 3	9922	9068	1800	6	1306
1 in 4	9959	9032	1350	6	1276
1 in 5	9984	9008	1080	6	1262

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE_80
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360

DRAWING No. 80 (REFER TABLE 80)

No. OF BAYS : ONE
SPAN : 12.0 m
SPACING : 12.0 m
COLUMN HEIGHT : 9.5 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS :
CONCRETE : M 25
STEEL : Fe 415



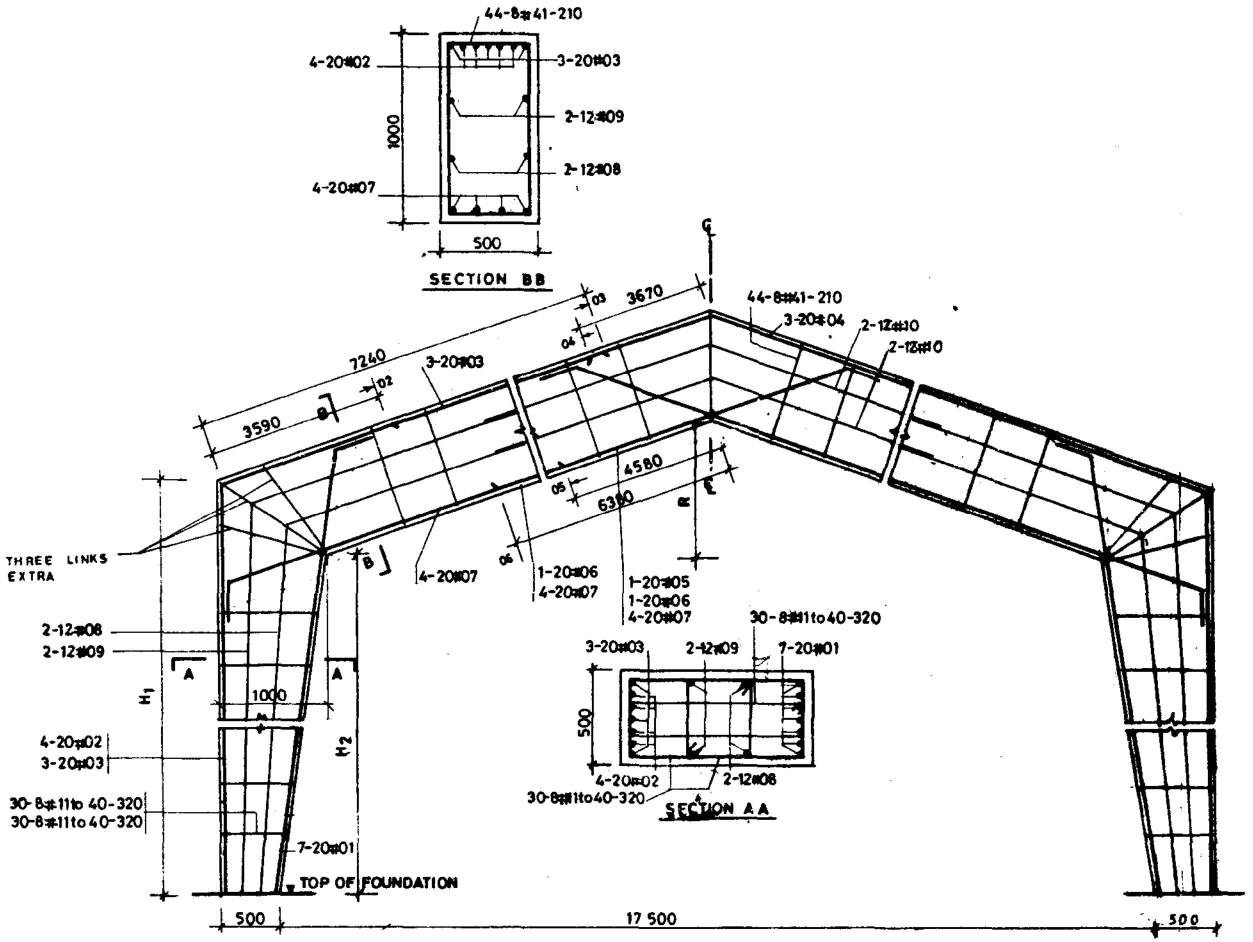
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS PRINCIPAL RAFTER No. OF PURLINS	 SPACING
1 in 3	6817	6176	2850	8	1369
1 in 4	6846	6149	2138	8	1338
1 in 5	6864	6131	1710	8	1323

NOTE

1 ALL DIMENSIONS ARE IN mm
2 FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE-81
3 DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE : 100
b. RIDGE : 300

DRAWING No. 81 (REFER TABLE 81)

No. OF BAYS : ONE
SPAN : 18.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 6.5 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS
CONCRETE : M25
STEEL : Fe 415



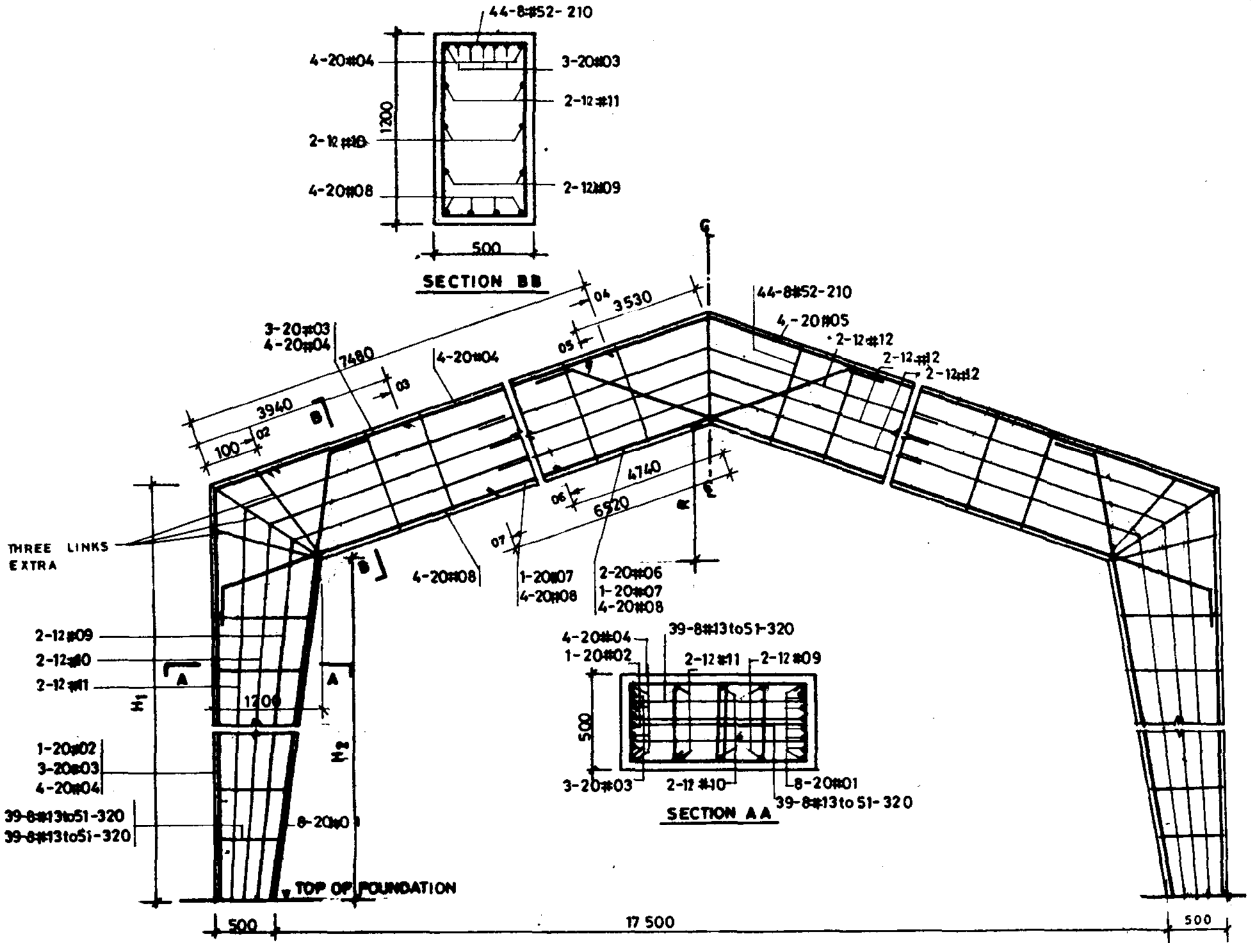
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS PRINCIPAL RAFTER No. OF PURLINS	SPACING
1 in 3	9854	9140	2833	8	1376
1 in 4	9885	9110	2125	8	1345
1 in 5	9905	9090	1700	8	1330

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE – 82
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300

DRAWING No. 82 (REFER TABLE 82)

No. OF BAYS	: ONE
SPAN	: 18.0 m
SPACING	: 6.0 m
COLUMN HEIGHT	: 9.5 m
SUPPORT CONDITION	: HINGED
FOR ALL WIND AND SEISMIC ZONES	
MATERIALS :	
CONCRETE	: M25
STEEL	: Fe 415



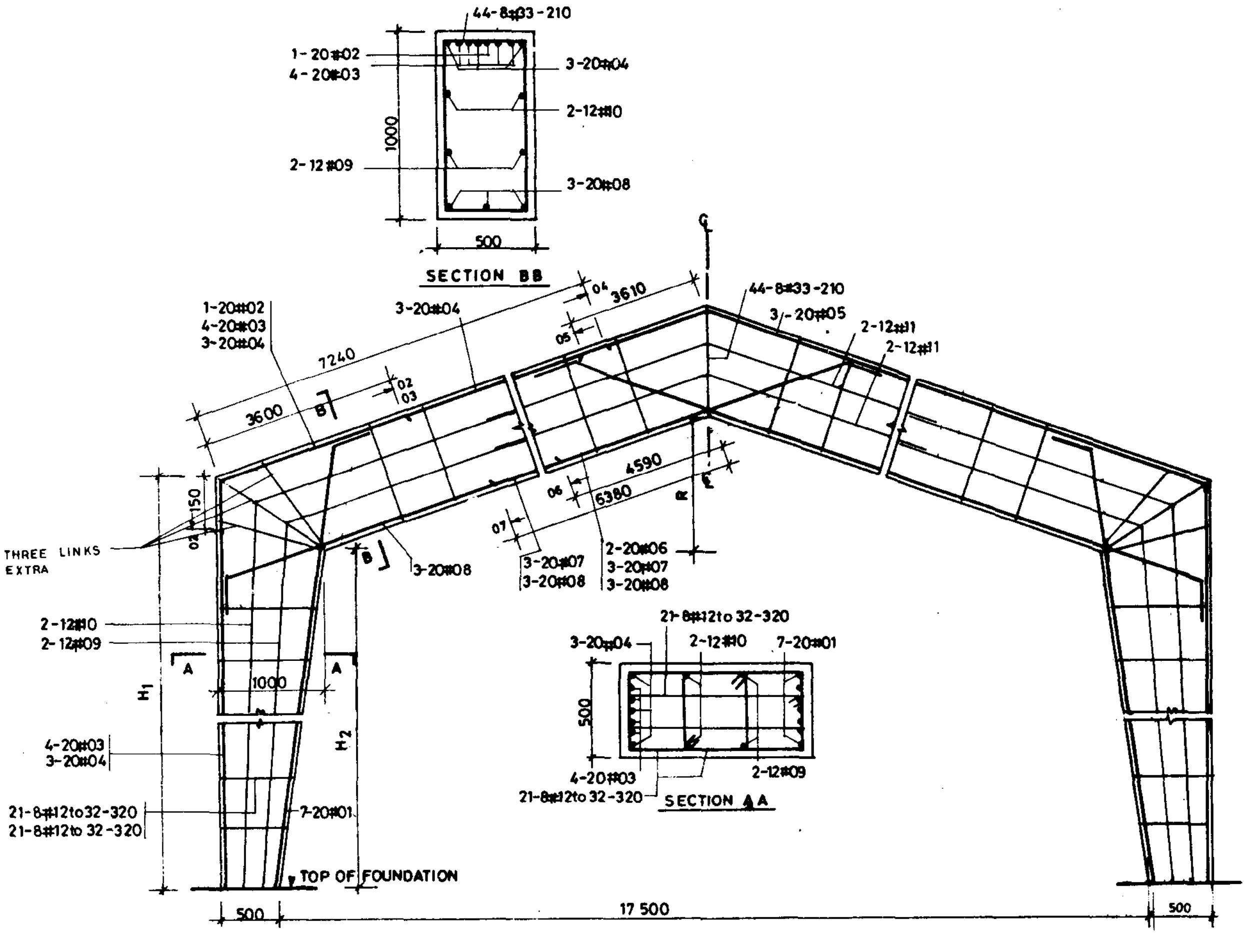
DRAWING No. 83 (REFER TABLE 83)

SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS PRINCIPAL RAFTER No. OF PURLINS	 SPACING
1 in 3	12924	12068	2800	8	1392
1 in 4	12961	12032	2100	8	1361
1 in 5	12986	12008	1680	8	1346

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE – 83
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300

No. OF BAYS : ONE
SPAN : 18.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 12.5 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS :
CONCRETE : M 25
STEEL : Fe 415



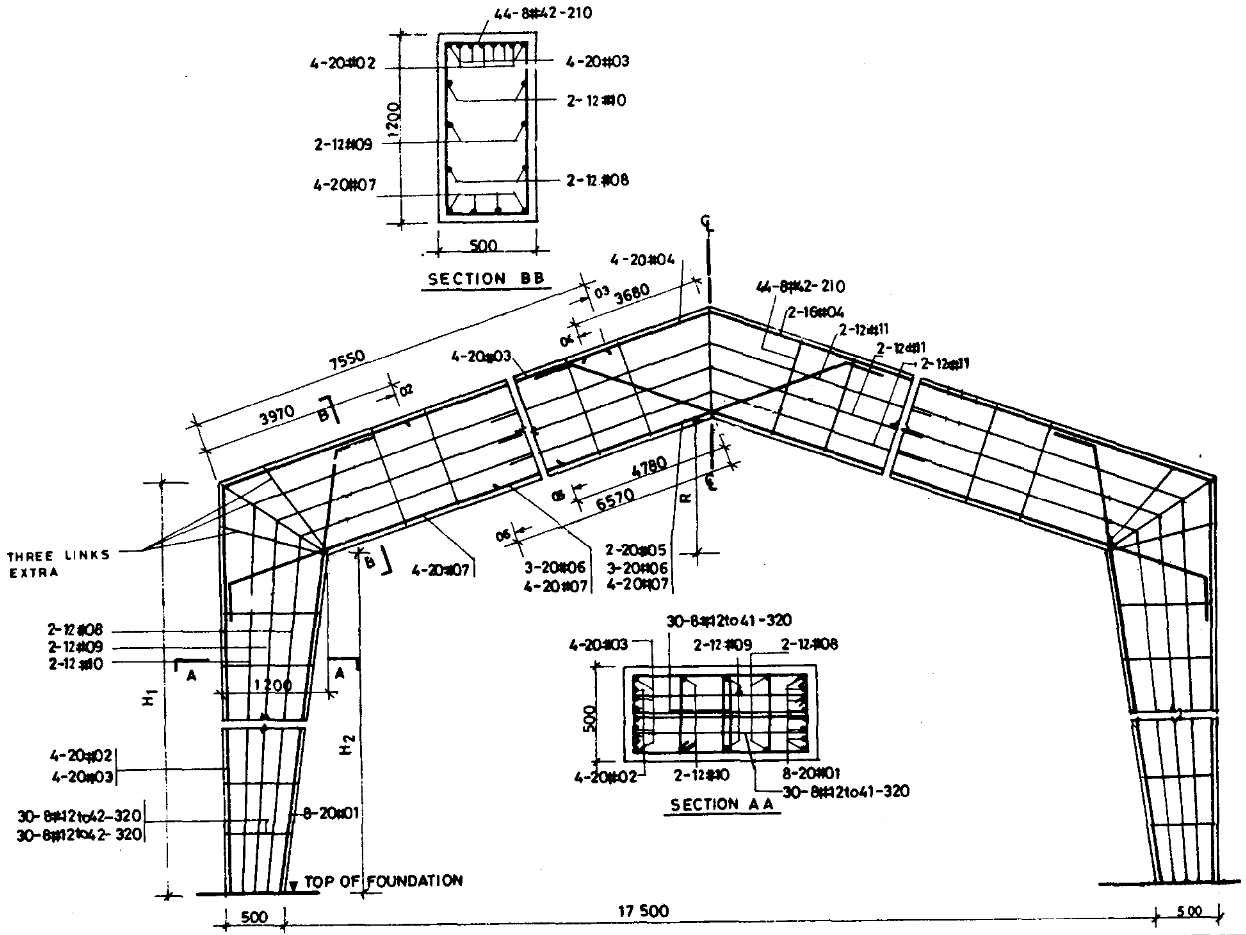
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS PRINCIPAL RAFTER No. OF PURLINS	 SPACING
1 in 3	6851	6140	2833	8	1369
1 in 4	6883	6110	2125	8	1338
1 in 5	6903	6090	1700	8	1323

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE. 84
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360

DRAWING No. 84 (REFER TABLE 84)

No. OF BAYS : ONE
SPAN : 18.0 m
SPACING : 12.0 m
COLUMN HEIGHT : 6.5 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS :
CONCRETE : M 25
STEEL : Fe 415



SLOPE	H₁	H₂	R	No. AND SPACING OF PURLINS	
				PRINCIPAL RAFTER	
				No. OF PURLINS	SPACING
1 in 3	9922	9068	2800	8	1386
1 in 4	9959	9032	2100	8	1353
1 in 5	9984	9008	1680	8	1339

NOTE

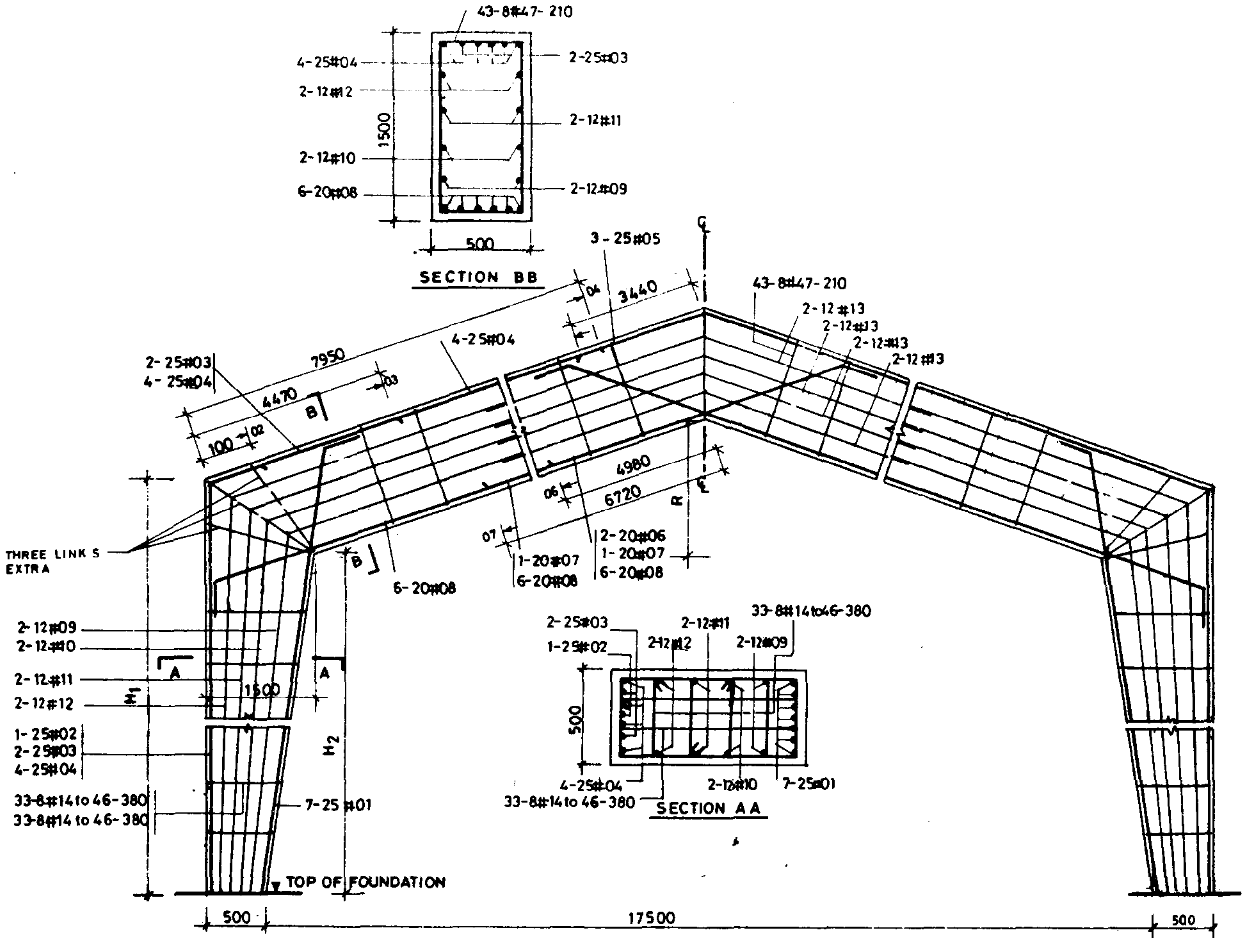
1 ALL DIMENSIONS ARE IN mm

2 FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE 85

3 DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a EXTERNAL COLUMN FACE : 100
b RIDGE : 360

DRAWING No. 85 (REFER TABLE 85)

No. OF BAYS : ONE
SPAN : 18.0 m
SPACING : 12.0 m
COLUMN HEIGHT : 9.5 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS :
CONCRETE : M 25
STEEL : Fe 415



SLOPE	H1	H2	R	No. AND SPACING OF PURLINS PRINCIPAL RAFTER No. OF PURLINS	 SPACING
1 in 3	13026	11960	2750	8	1409
1 in 4	13074	11915	2063	8	1377
1 in 5	13105	11885	1650	8	1362

NOTE

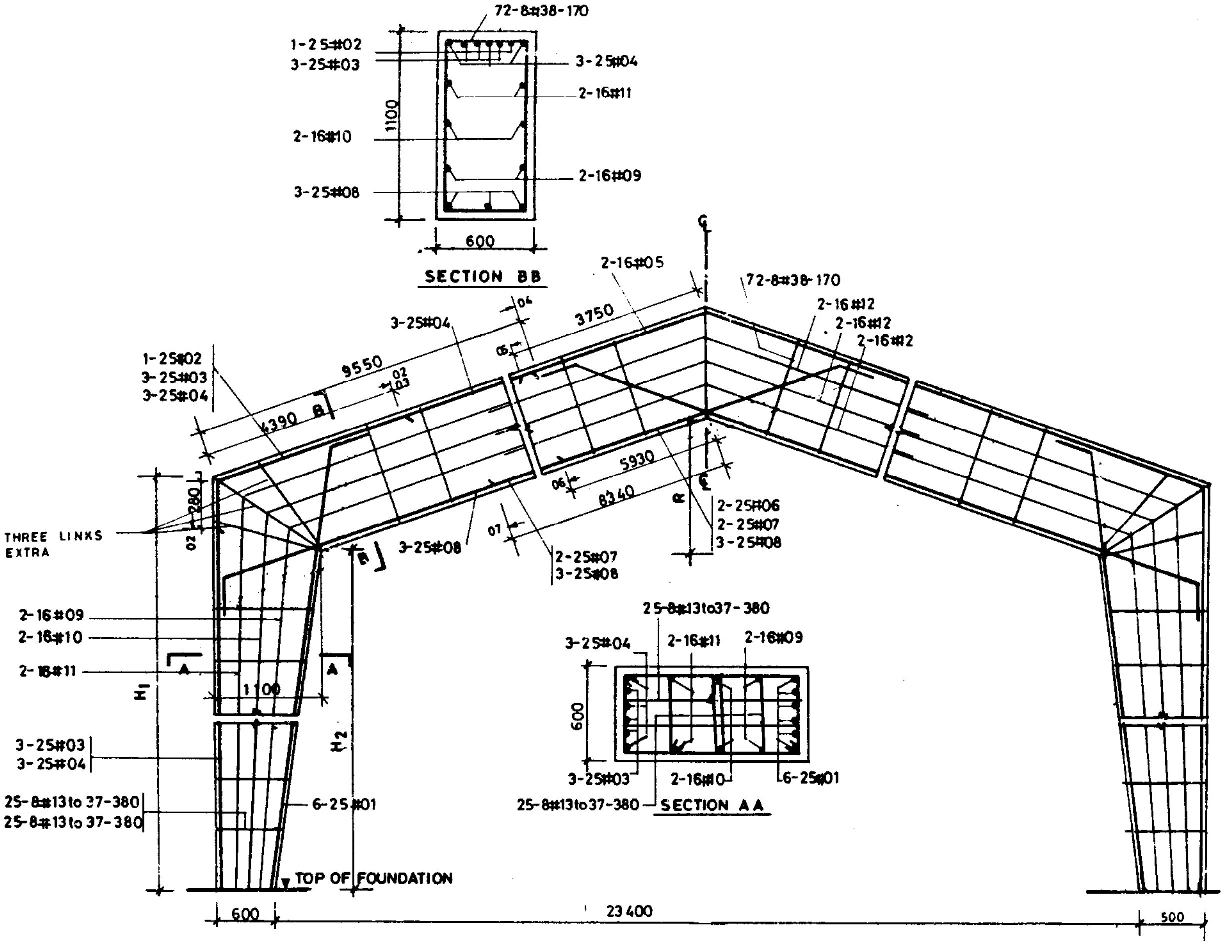
1 ALL DIMENSIONS ARE IN mm

2 FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE-86

3 DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE : 100
b. RIDGE : 360

DRAWING No. 86 (REFER TABLE 86)

No. OF BAYS : ONE
SPAN : 18.0 m
SPACING : 12.0 m
COLUMN HEIGHT : 12.5 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS :
CONCRETE : M25
STEEL : Fe415



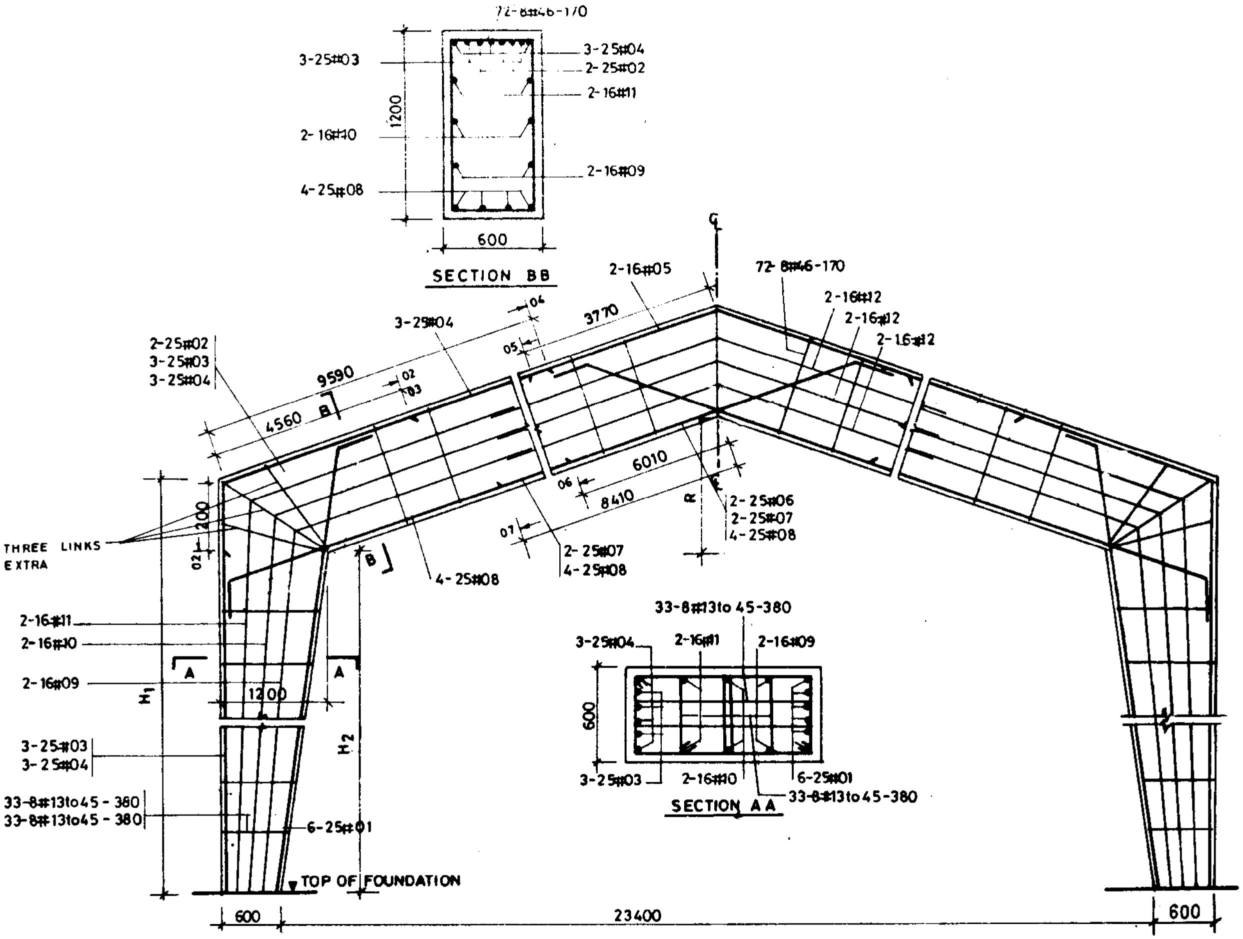
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS	
				PRINCIPAL RAFTER	
				No. OF PURLINS	SPACING
1 in 3	9889	9104	3817	11	1285
1 in 4	9924	9071	2863	10	1396
1 in 5	9946	9049	2290	10	1380

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE _ 87
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300

DRAWING No. 87 (REFER TABLE 87)

No. OF BAYS	: ONE
SPAN	: 24.0 m
SPACING	: 6.0 m
COLUMN HEIGHT	: 9.5 m
SUPPORT CONDITION	: HINGED
FOR ALL WIND AND SEISMIC ZONES	
MATERIALS	
CONCRETE	: M 25
STEEL	: Fe 415



SLOPE	H1	H2	R	No. AND SPACING OF PURLINS PRINCIPAL RAFTER No. OF PURLINS	SPACING
1 in 3	12925	12068	3800	11	1290
1 in 4	12963	12032	2850	10	1401
1 in 5	12987	12008	2280	10	1386

NOTE

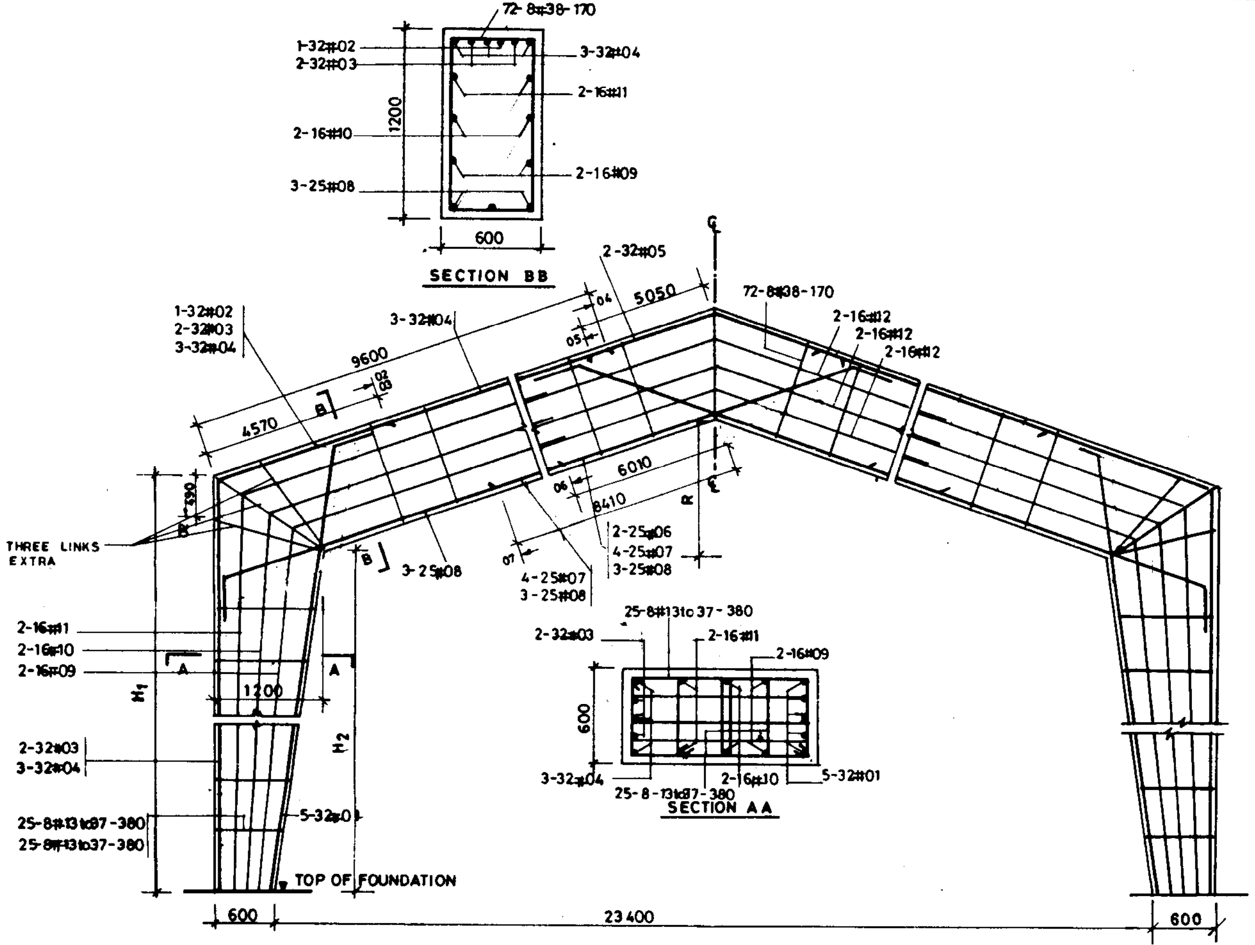
1 ALL DIMENSIONS ARE IN mm

2 FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE_88

3 DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
a. EXTERNAL COLUMN FACE : 100
b. RIDGE : 300

DRAWING No. 88 (REFER TABLE 88)

No. OF BAYS	: ONE
SPAN	: 24.0 m
SPACING	: 6.0 m
COLUMN HEIGHT	: 12. 5 m
SUPPORT CONDITION	: HINGED
FOR ALL WIND AND SEISMIC ZONES	
MATERIALS	
CONCRETE	: M 25
STEEL	: Fe 415



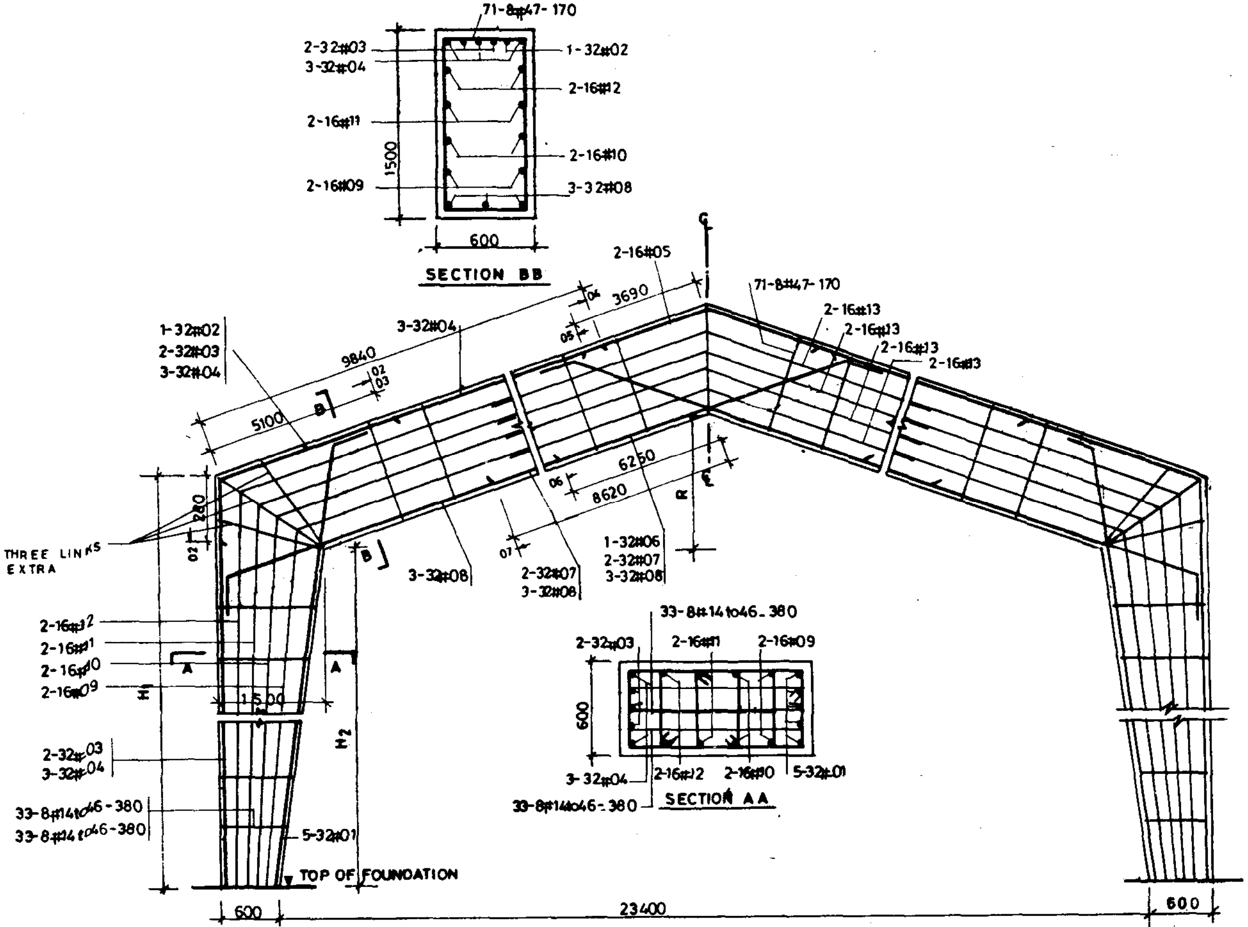
SLOPE	H1	H2	R	No. AND SPACING OF PURLINS PRINCIPAL RAFTER	
				No. OF PURLINS	SPACING
1 in 3	9923	9068	3800	11	1302
1 in 4	9961	9032	2850	10	1396
1 in 5	9985	9008	2280	10	1399

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE _89
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360

DRAWING No. 89 (REFER TABLE 89)

No. OF BAYS	: ONE
SPAN	: 24.0 m
SPACING	: 12.0 m
COLUMN HEIGHT	: 9.5 m
SUPPORT CONDITION	:
FOR ALL WIND AND SEISMIC ZONES	
MATERIALS :	
CONCRETE	: M 25
STEEL	: Fe 415



SLOPE	H1	H2	R	No. AND SPACING OF PURLINS	
				PRINCIPAL RAFTER	
				No. OF PURLINS	SPACING
1 in 3	13027	11960	3750	11	1285
1 in 4	13075	11915	2813	10	1414
1 in 5	13106	11885	2250	10	1380

NOTE

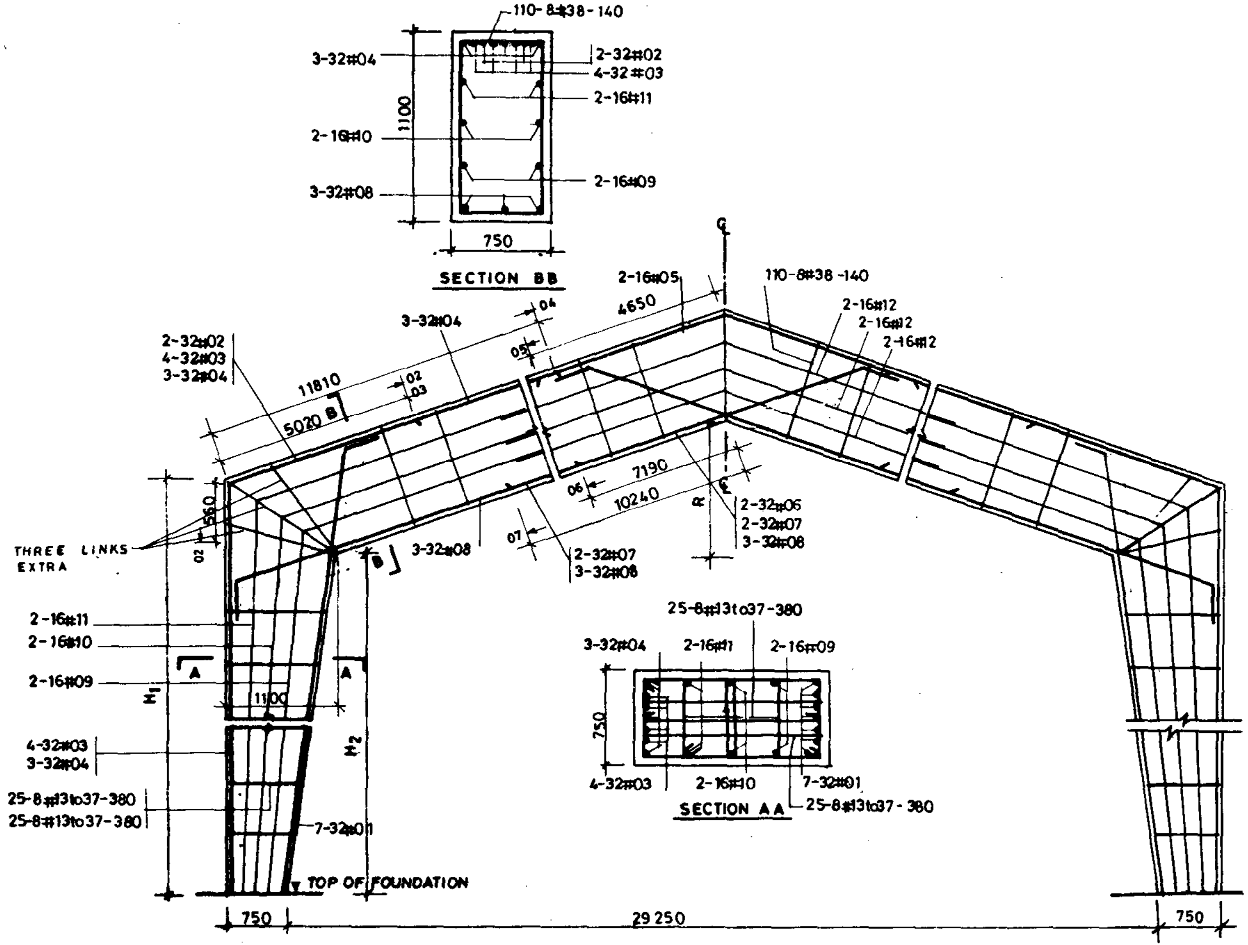
1 ALL DIMENSIONS ARE IN mm

2 FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE_90

3 DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
a. EXTERNAL COLUMN FACE : 100
b. RIDGE : 360

DRAWING No. 90 (REFER TABLE 90)

No. OF BAYS	: ONE
SPAN	: 24.0 m
SPACING	: 12.0 m
COLUMN HEIGHT	: 12.5 m
SUPPORT CONDITION	: HINGED
FOR ALL WIND AND SEISMIC ZONES	
MATERIALS	
CONCRETE	: M 25
STEEL	: Fe 415



SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS	
				PRINCIPAL RAFTER	
				No. OF PURLINS	SPACING
1 in 3	9991	9104	4817	13	1334
1 in 4	9925	9071	3613	13	1304
1 in 5	9947	9049	2890	12	1407

NOTE

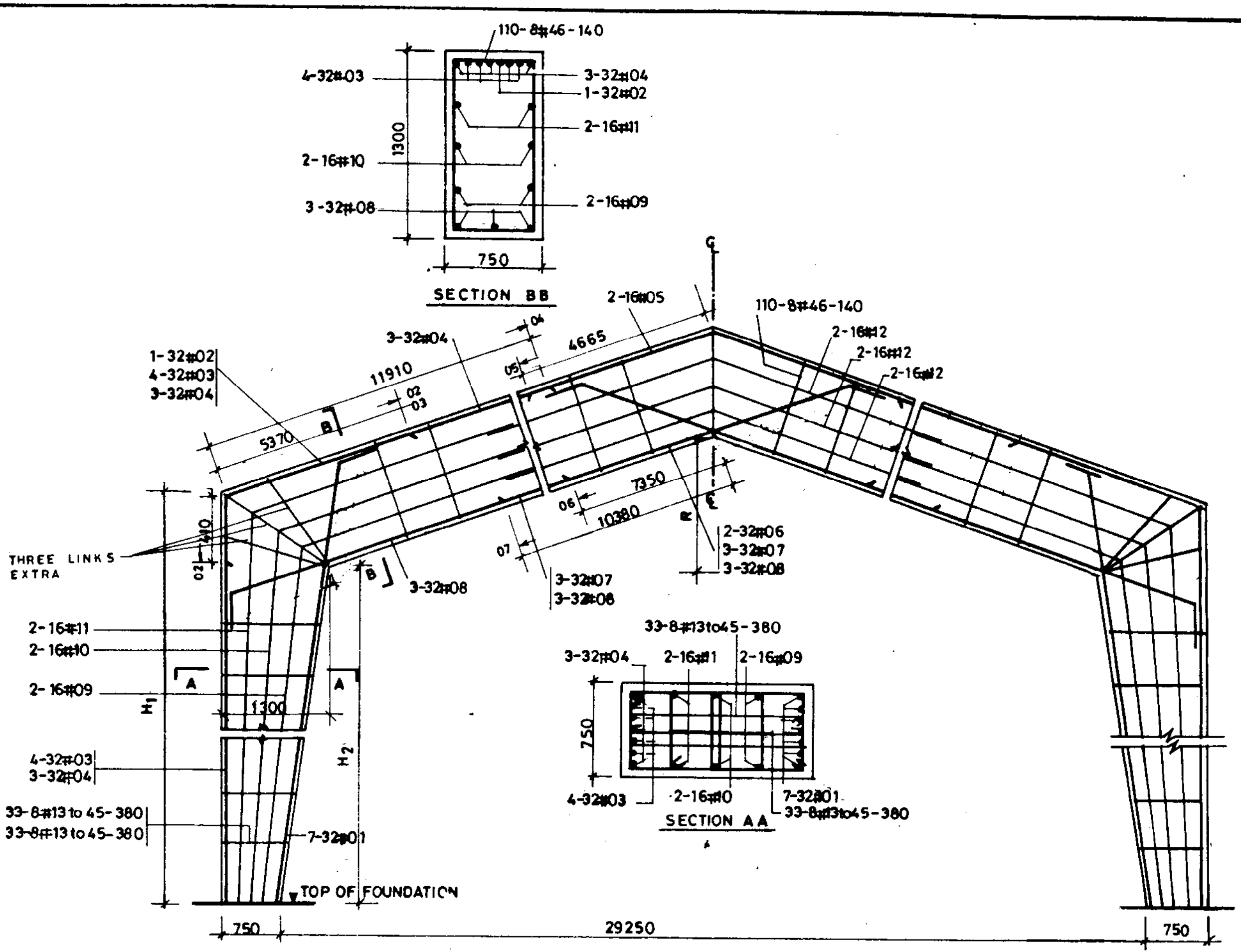
1 ALL DIMENSIONS ARE IN mm

2 FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE - 91

3 DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
a. EXTERNAL COLUMN FACE : 100
b. RIDGE : 300

DRAWING No. 91 (REFER TABLE 91)

No. OF BAYS : ONE
SPAN : 30.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 9.5 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS
CONCRETE : M 25
STEEL : Fe 415



SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS	
				PRINCIPAL RAFTER	
				No. OF PURLINS	SPACING
1 in 3	12961	12032	4783	13	1343
1 in 4	13002	11993	3588	13	1313
1 in 5	13028	11967	2870	12	1416

NOTE

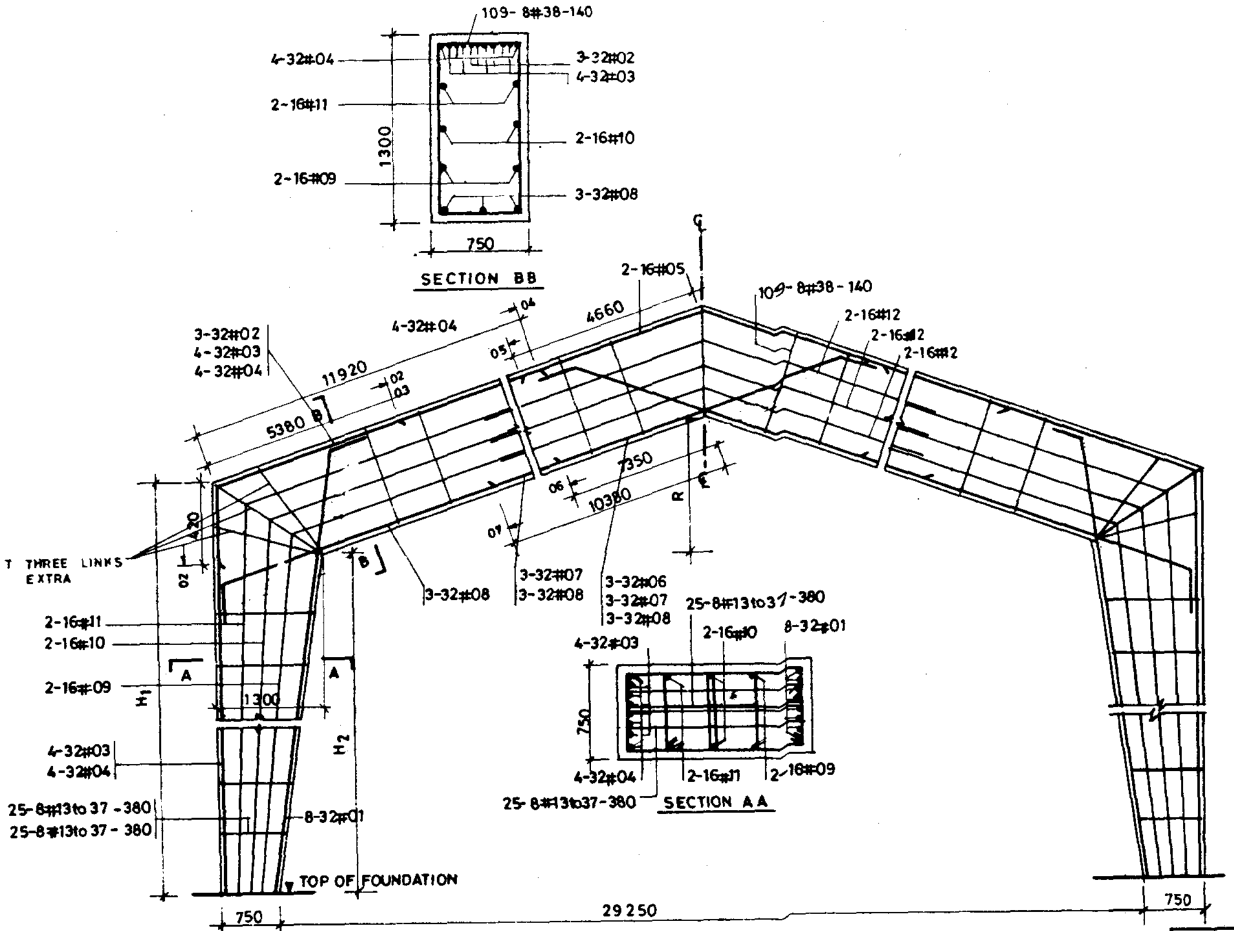
1 ALL DIMENSIONS ARE IN mm

2 FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE_92

3 DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
a. EXTERNAL COLUMN FACE : 100
b. RIDGE : 300

DRAWING No. 92 (REFER TABLE 92)

No. OF BAYS : ONE
SPAN : 30.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 12.5 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS :
CONCRETE : M25
STEEL : Fe 415



SLOPE	H1	H2	R	No. AND SPACING OF PURLINS PRINCIPAL RAFTER No. OF PURLINS	No. AND SPACING OF PURLINS PRINCIPAL RAFTER SPACING
1 in 3	9951	9032	4783	13	1339
1 in 4	10000	8993	3588	13	1309
1 in 5	10026	8967	2870	12	1412

NOTE

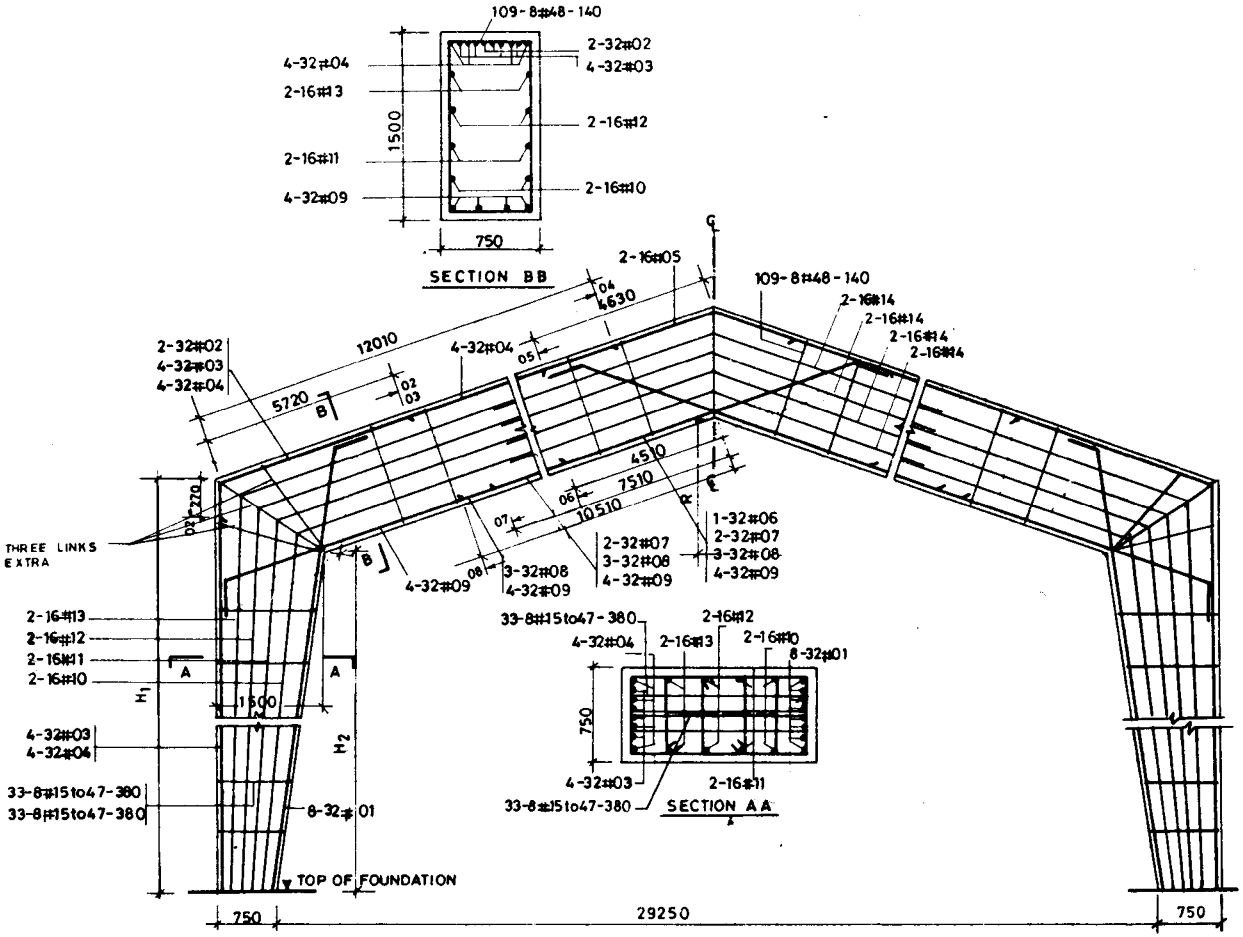
1 ALL DIMENSIONS ARE IN mm

2 FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE. 93

3 DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE : 100
b. RIDGE : 360

DRAWING No. 93 (REFER TABLE 93)

No. OF BAYS : ONE
SPAN : 30.0 m
SPACING : 12. 0 m
COLUMN HEIGHT : 9. 5 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS
CONCRETE : M25
STEEL : Fe 415



SLOPE	H$_1$	H$_2$	R	No. AND SPACING OF PURLINS	
				PRINCIPAL RAFTER	
				No. OF PURLINS	SPACING
1 in 3	13029	11960	4750	13	1348
1 in 4	13077	11915	3563	13	1318
1 in 5	13107	11885	2850	13	1304

NOTE

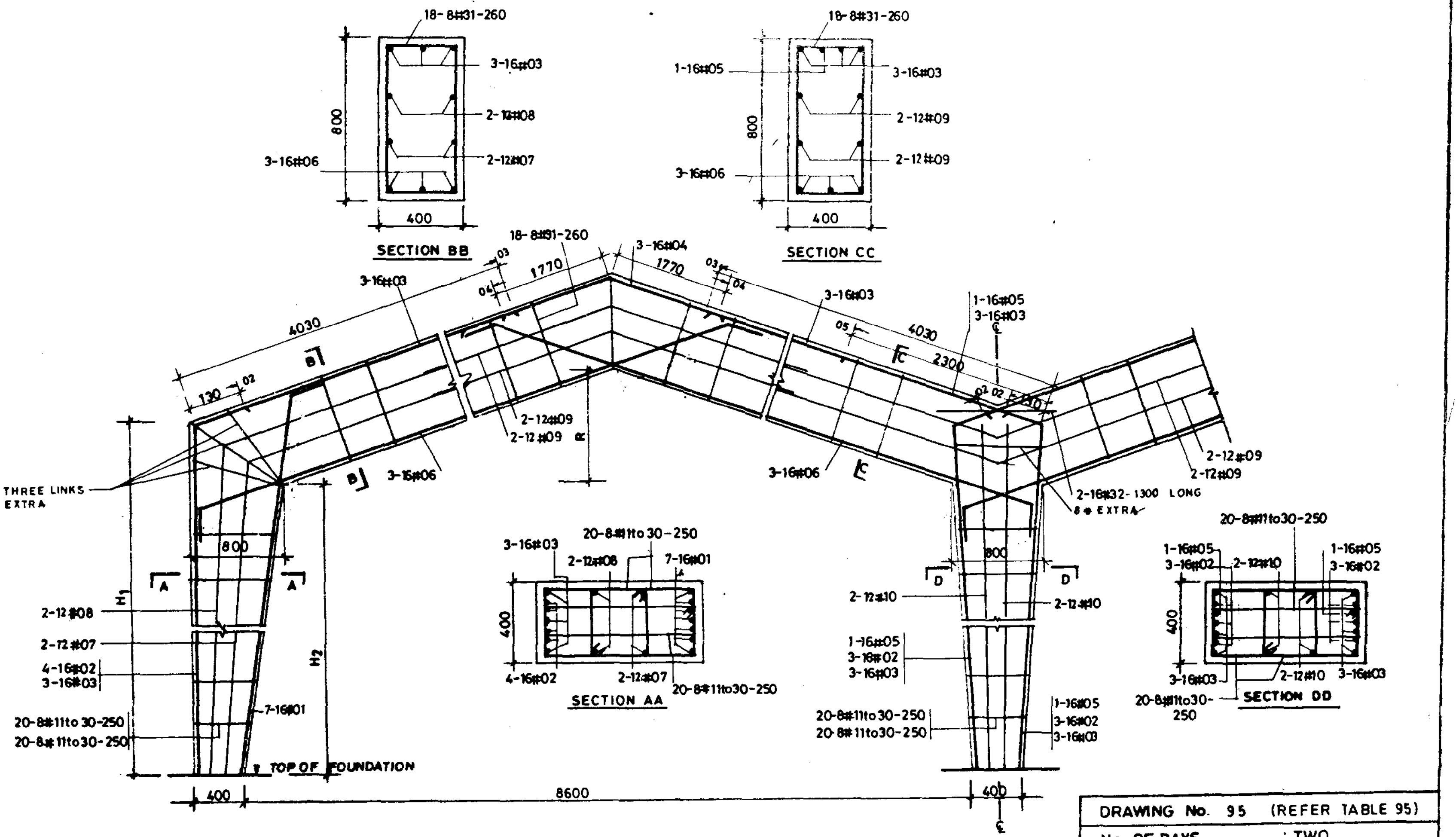
1 ALL DIMENSIONS ARE IN mm

2 FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE_94

3 DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
a. EXTERNAL COLUMN FACE : 100
b. RIDGE : 360

DRAWING No. 94 (REFER TABLE 94)

No. OF BAYS : ONE
SPAN : 30.0 m
SPACING : 12.0 m
COLUMN HEIGHT : 12.5 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS
CONCRETE : M25
STEEL : Fe415



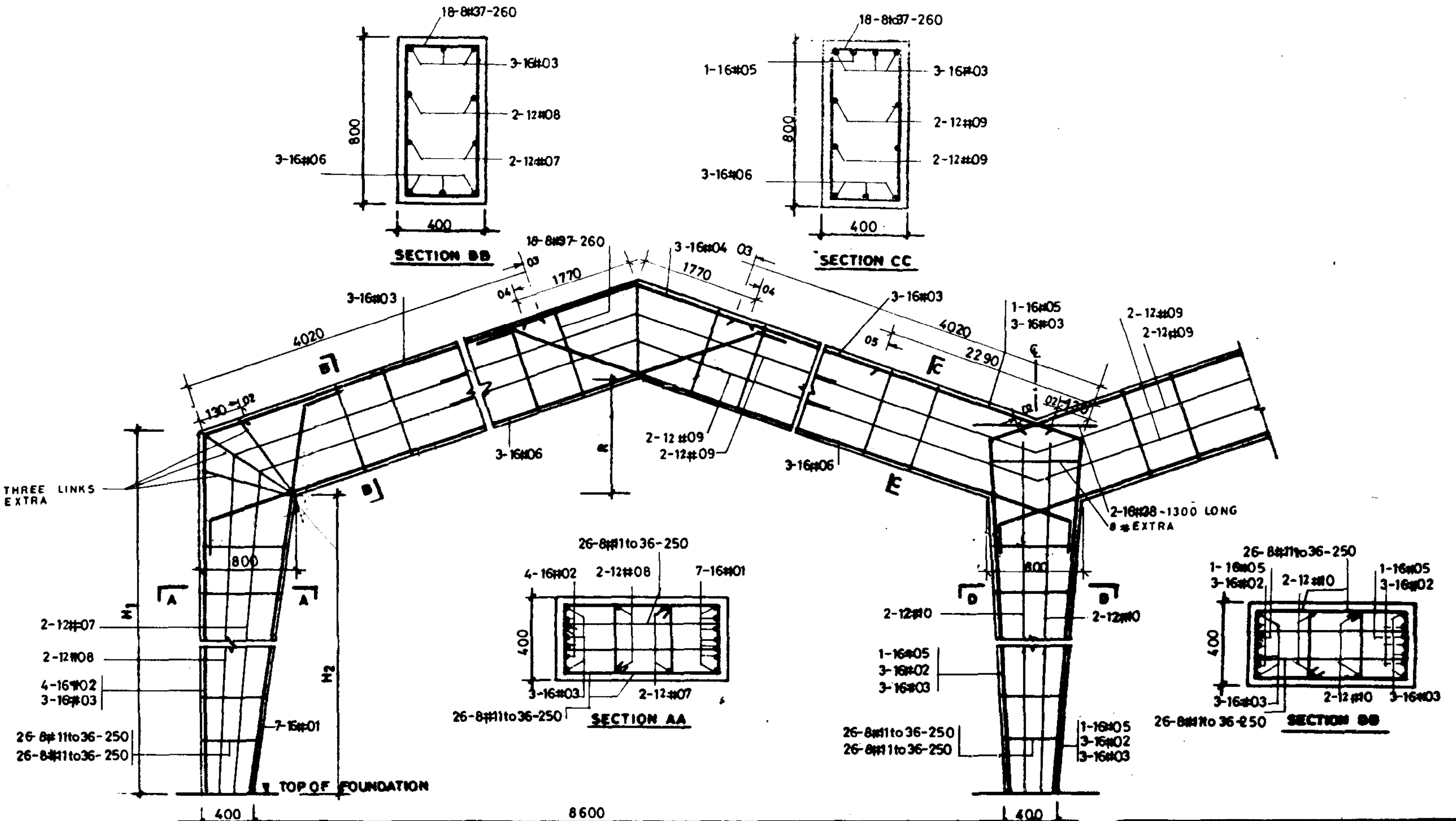
<table>
<tr><th rowspan="3">SLOPE</th><th rowspan="3">H_1</th><th rowspan="3">H_2</th><th rowspan="3">R</th><th colspan="4">No. AND SPACING OF PURLINS</th></tr>
<tr><th colspan="2">EXTERIOR RAFTER</th><th colspan="2">INTERIOR RAFTER</th></tr>
<tr><th>No OF PURLINS</th><th>SPACING</th><th>No OF PURLINS</th><th>SPACING</th></tr>
<tr><td>1 in 3</td><td>5280</td><td>4712</td><td>1367</td><td>5</td><td>1198</td><td>4</td><td>1381</td></tr>
<tr><td>1 in 4</td><td>5306</td><td>4688</td><td>1025</td><td>5</td><td>1170</td><td>4</td><td>1346</td></tr>
<tr><td>1 in 5</td><td>5322</td><td>4672</td><td>820</td><td>5</td><td>1156</td><td>4</td><td>1330</td></tr>
</table>

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE – 95
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300
   c. VALLEY : 300

DRAWING No. 95 (REFER TABLE 95)

No. OF BAYS : TWO
SPAN : 9.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 5.0 m
SUPPORT CONDITION FOR ALL WIND AND SEISMIC ZONES : HINGED
MATERIALS :
CONCRETE : M 25
STEEL : Fe 415



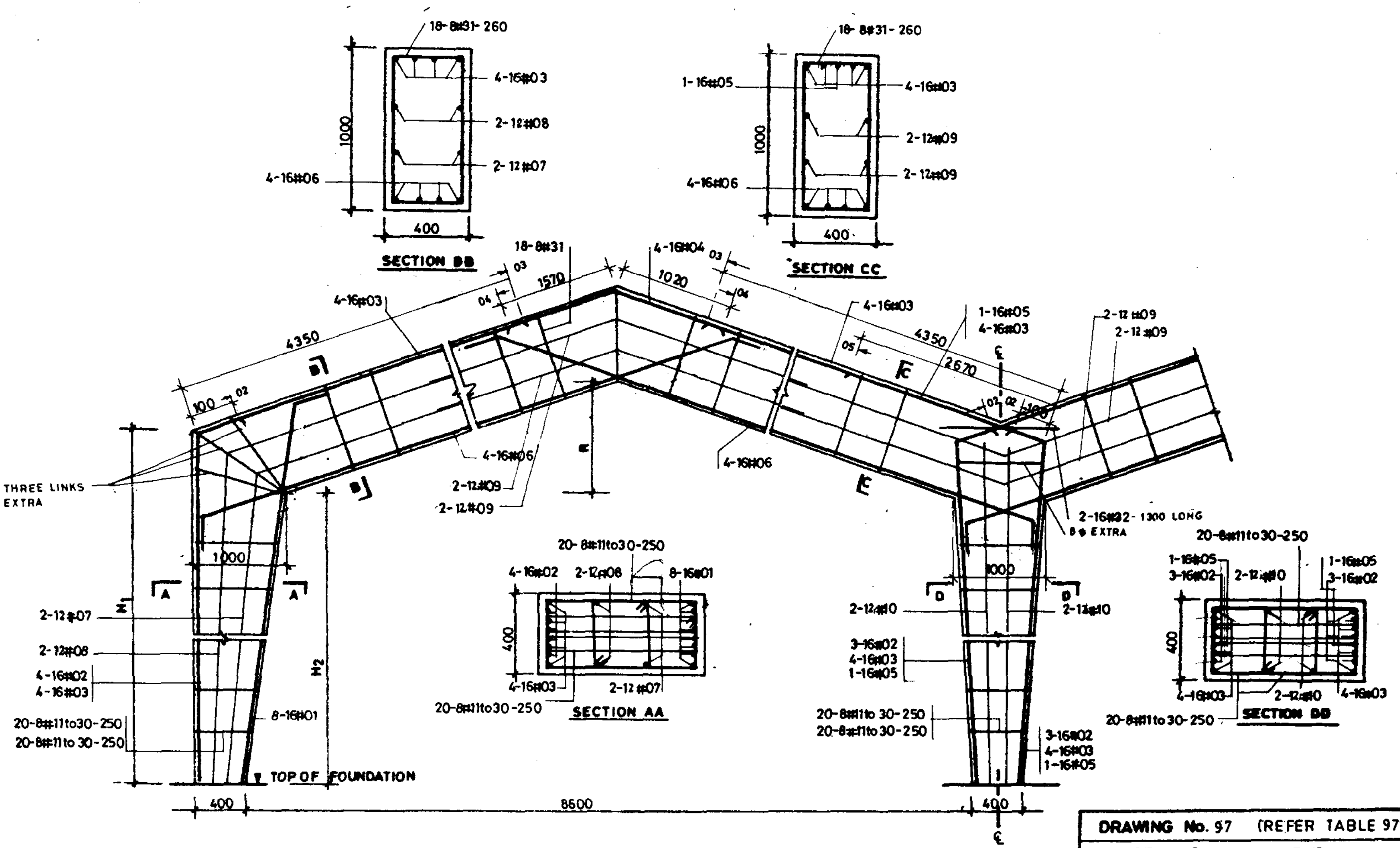
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	6782	6212	1367	5	1197	4	1381
1 in 4	6807	6188	1025	5	1168	4	1346
1 in 5	6824	6172	820	5	1155	4	1330

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE - 96
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300
   c. VALLEY : 300

DRAWING No. 96 (REFER TABLE 96)

No. OF BAYS : TWO
SPAN : 9.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 6.5 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS :
CONCRETE : M 25
STEEL : Fe415



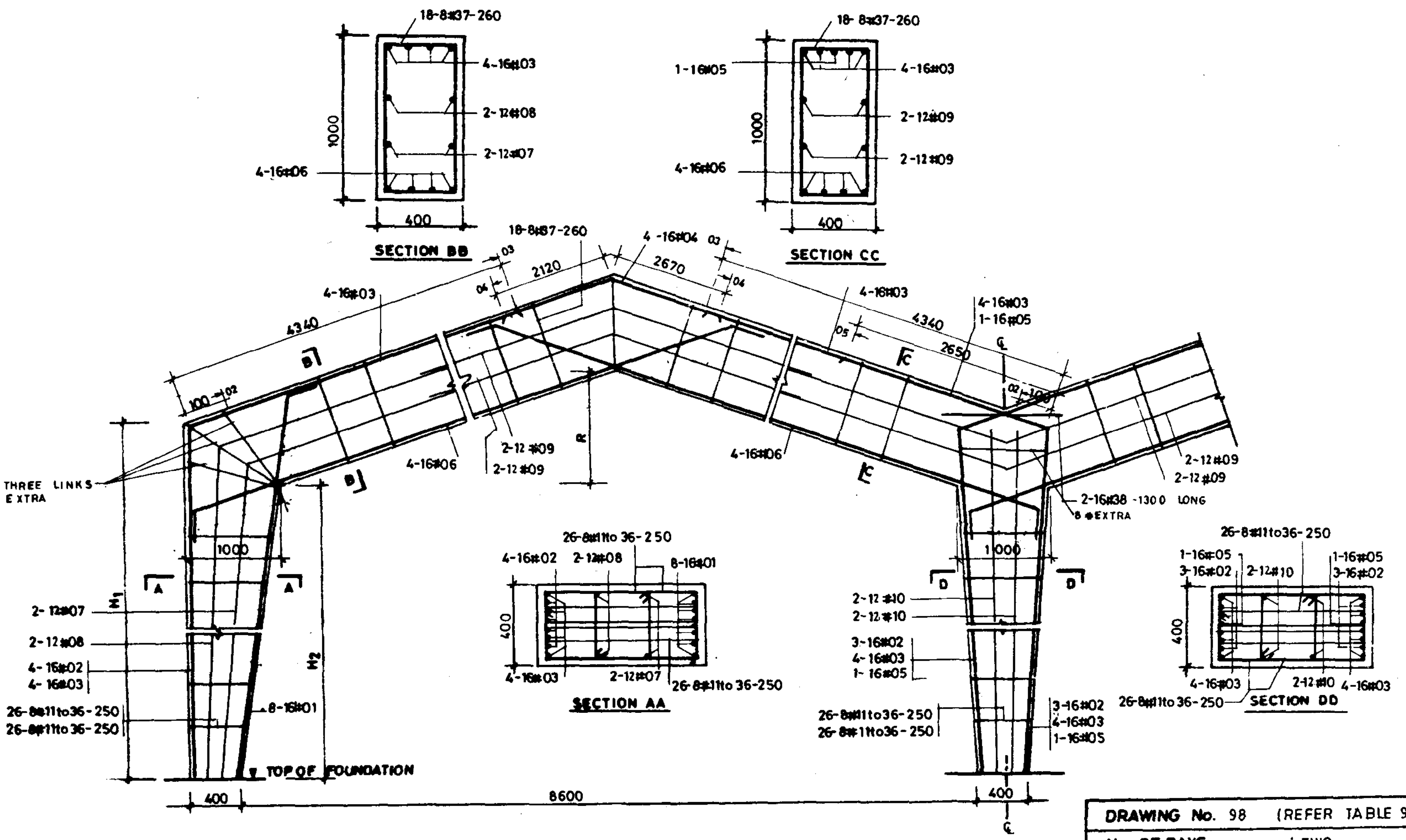
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No OF PURLINS	SPACING	No OF PURLINS	SPACING
1 in 3	5345	4640	1333	5	1215	4	1361
1 in 4	5378	4610	1000	5	1186	4	1326
1 in 5	5399	4590	800	5	1173	4	1310

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE_97
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360
   c. VALLEY : 300

DRAWING No. 97 (REFER TABLE 97)

No. OF BAYS : TWO
SPAN : 9.0 m
SPACING : 12.0 m
COLUMN HEIGHT : 5.0 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS :
CONCRETE : M 25
STEEL : Fe 415



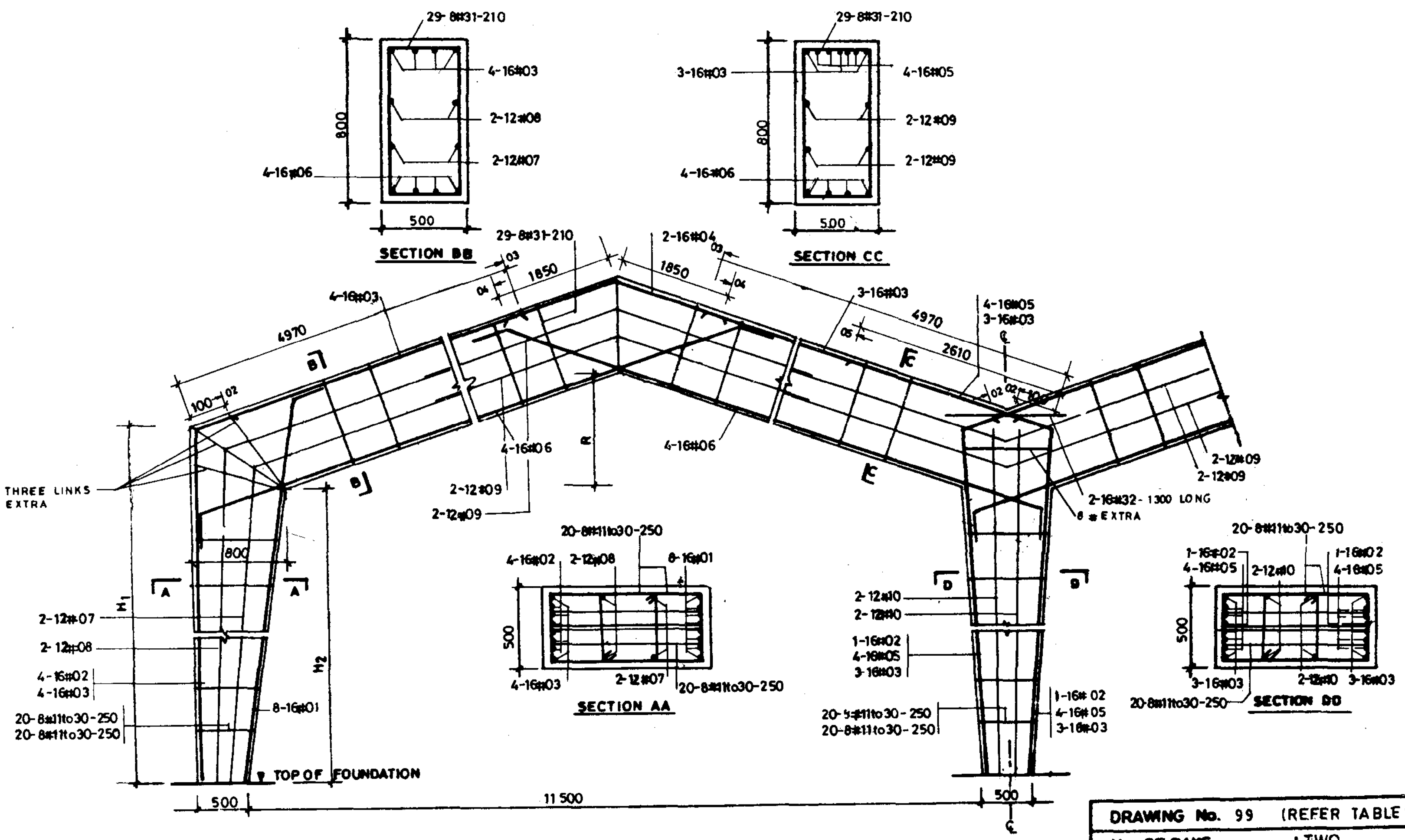
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No OF PURLINS	SPACING	No OF PURLINS	SPACING
1 in 3	6849	6140	1333	5	1212	4	1361
1 in 4	6881	6110	1000	5	1183	4	1326
1 in 5	6902	6090	800	5	1170	4	1310

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE - 98
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360
   c. VALLEY : 300

DRAWING No. 98 (REFER TABLE 98)

No. OF BAYS	: TWO
SPAN	: 9.0 m
SPACING	: 12.0 m
COLUMN HEIGHT	: 6.5 m
SUPPORT CONDITION FOR ALL WIND AND SEISMIC ZONES	: HINGED
MATERIALS :	
CONCRETE	: M 25
STEEL	: Fe 415



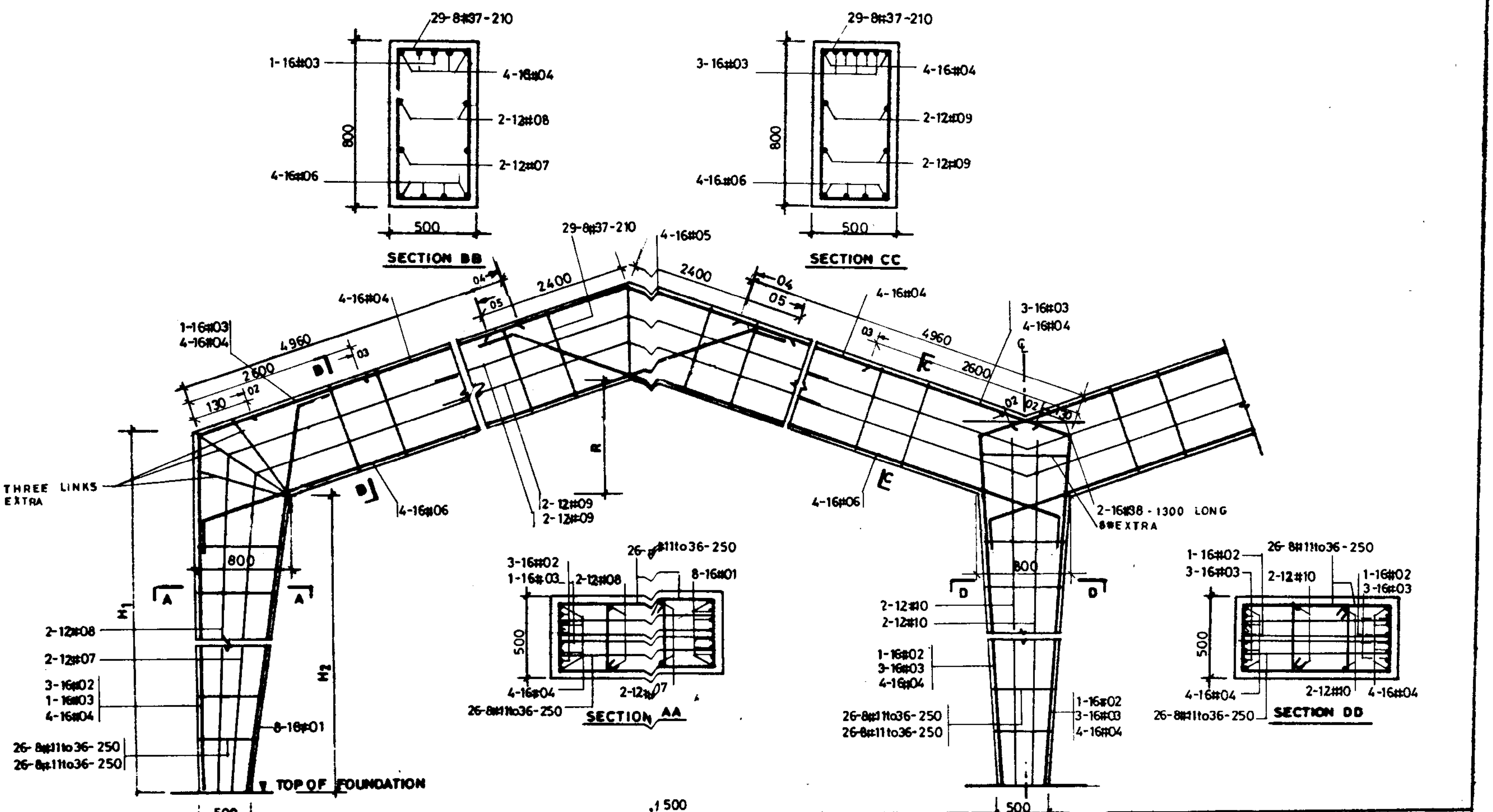
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No OF PURLINS	SPACING	No OF PURLINS	SPACING
1 in 3	5282	4712	1867	6	1273	6	1145
1 in 4	5307	4688	1400	6	1243	5	1396
1 in 5	5324	4672	1120	6	1230	5	1380

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE_99
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300
   c VALLEY : 300

DRAWING No. 99 (REFER TABLE 99)

NO. OF BAYS : TWO
SPAN : 12.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 5.0 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS :
CONCRETE : M 25
STEEL : Fe 415



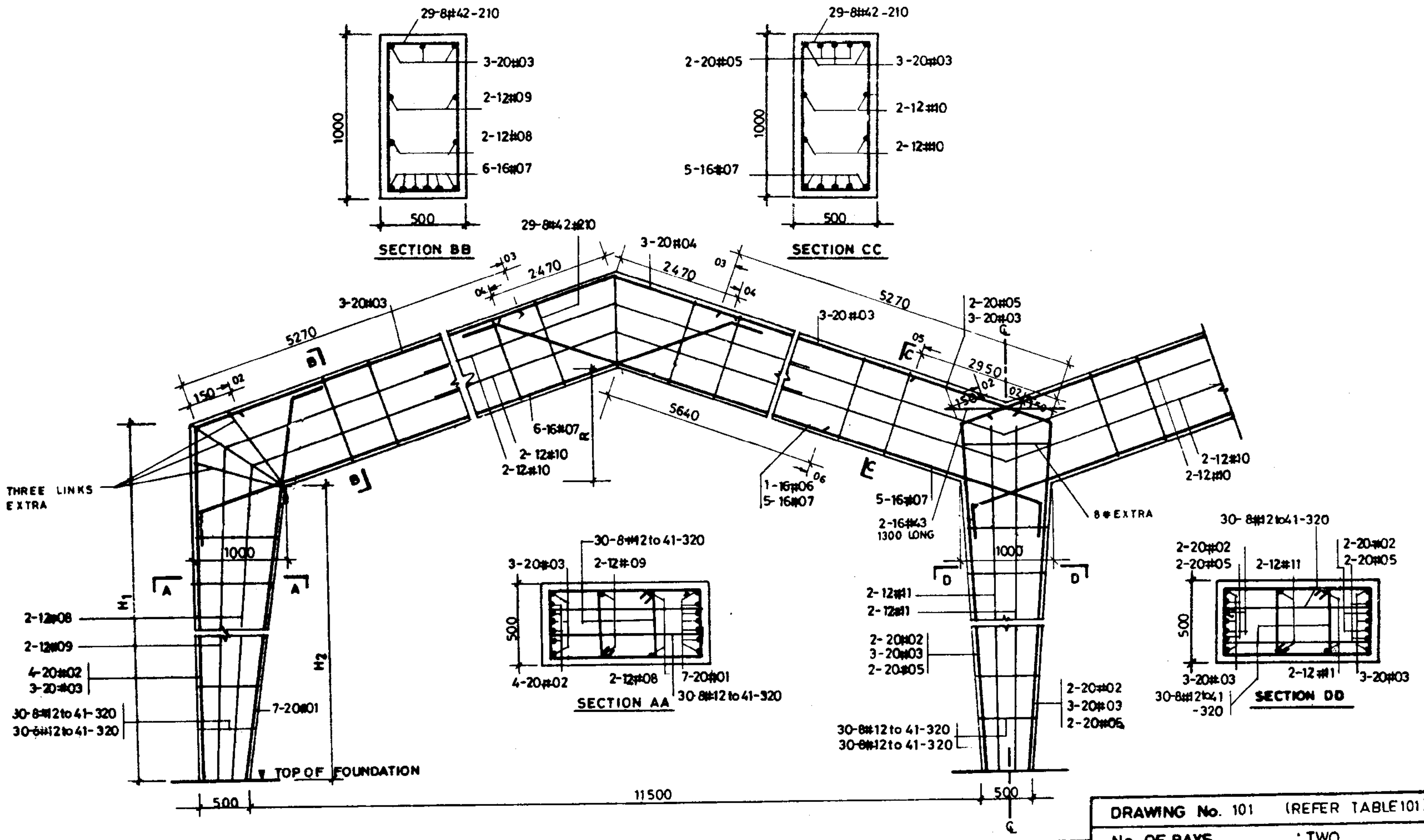
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	6784	6212	1867	6	1272	6	1145
1 in 4	6809	6188	1400	6	1243	5	1396
1 in 5	6825	6172	1120	6	1229	5	1380

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE - 100
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   - a. EXTERNAL COLUMN FACE : 100
   - b. RIDGE : 300
   - c VALLEY : 300

DRAWING No. 100 (REFER TABLE 100)

No. OF BAYS : TWO
SPAN : 12.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 6.5 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS :
CONCRETE : M25
STEEL : Fe 415



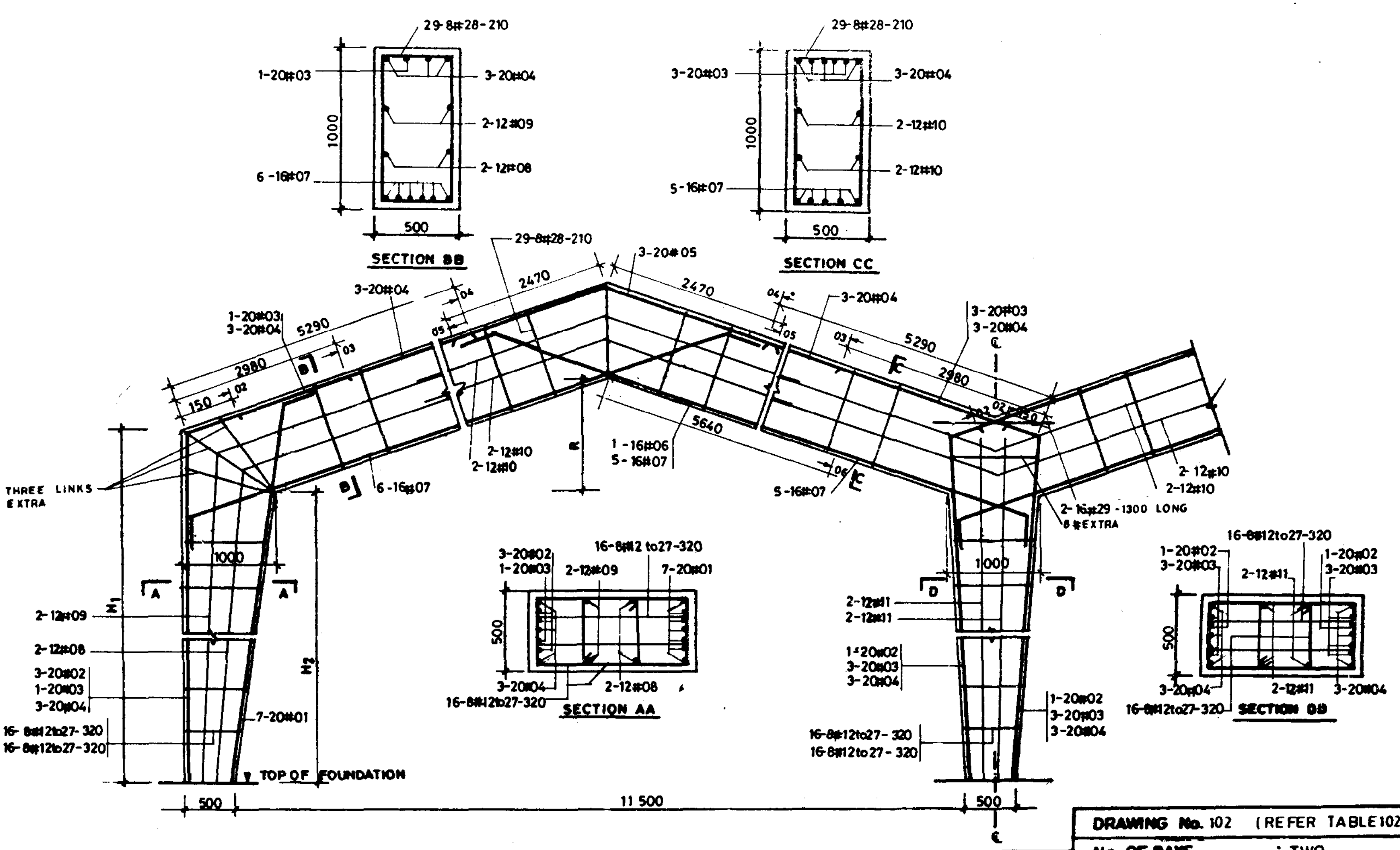
<table>
<tr><th rowspan="3">SLOPE</th><th rowspan="3">H_1</th><th rowspan="3">H_2</th><th rowspan="3">R</th><th colspan="4">No. AND SPACING OF PURLINS</th></tr>
<tr><th colspan="2">EXTERIOR RAFTER</th><th colspan="2">INTERIOR RAFTER</th></tr>
<tr><th>No OF PURLINS</th><th>SPACING</th><th>No OF PURLINS</th><th>SPACING</th></tr>
<tr><td>1 in 3</td><td>9854</td><td>9140</td><td>1833</td><td>6</td><td>1295</td><td>6</td><td>1145</td></tr>
<tr><td>1 in 4</td><td>9885</td><td>9110</td><td>1375</td><td>6</td><td>1264</td><td>5</td><td>1396</td></tr>
<tr><td>1 in 5</td><td>9906</td><td>9090</td><td>1100</td><td>6</td><td>1250</td><td>5</td><td>1380</td></tr>
</table>

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE_101
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300
   c. VALLEY : 300

DRAWING No. 101 (REFER TABLE 101)

No. OF BAYS : TWO
SPAN : 12.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 9.5 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS :
CONCRETE : M 25
STEEL : Fe 415



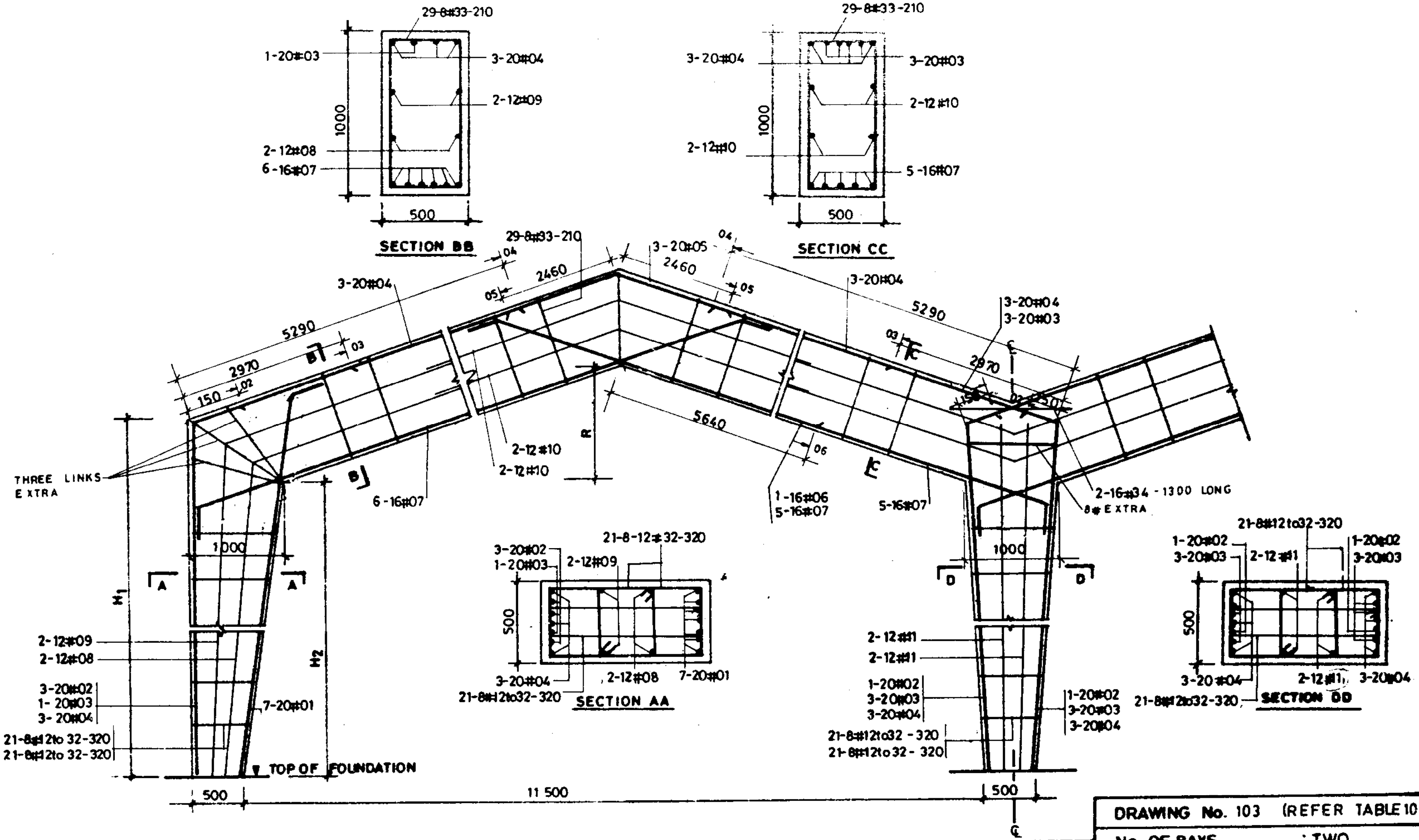
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No OF PURLINS	SPACING	No OF PURLINS	SPACING
1 in 3	5348	4640	1833	6	1287	5	1416
1 in 4	5380	4610	1375	6	1257	5	1381
1 in 5	5404	4590	1100	6	1243	5	1365

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE 102
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360
   c. VALLEY : 300

DRAWING No. 102 (REFER TABLE 102)

No. OF BAYS	: TWO
SPAN	: 12.0 m
SPACING	: 12.0 m
COLUMN HEIGHT	: 5.0 m
SUPPORT CONDITION	: HINGED
FOR ALL WIND AND SEISMIC ZONES	
MATERIALS :	
CONCRETE	: M25
STEEL	: Fe 415



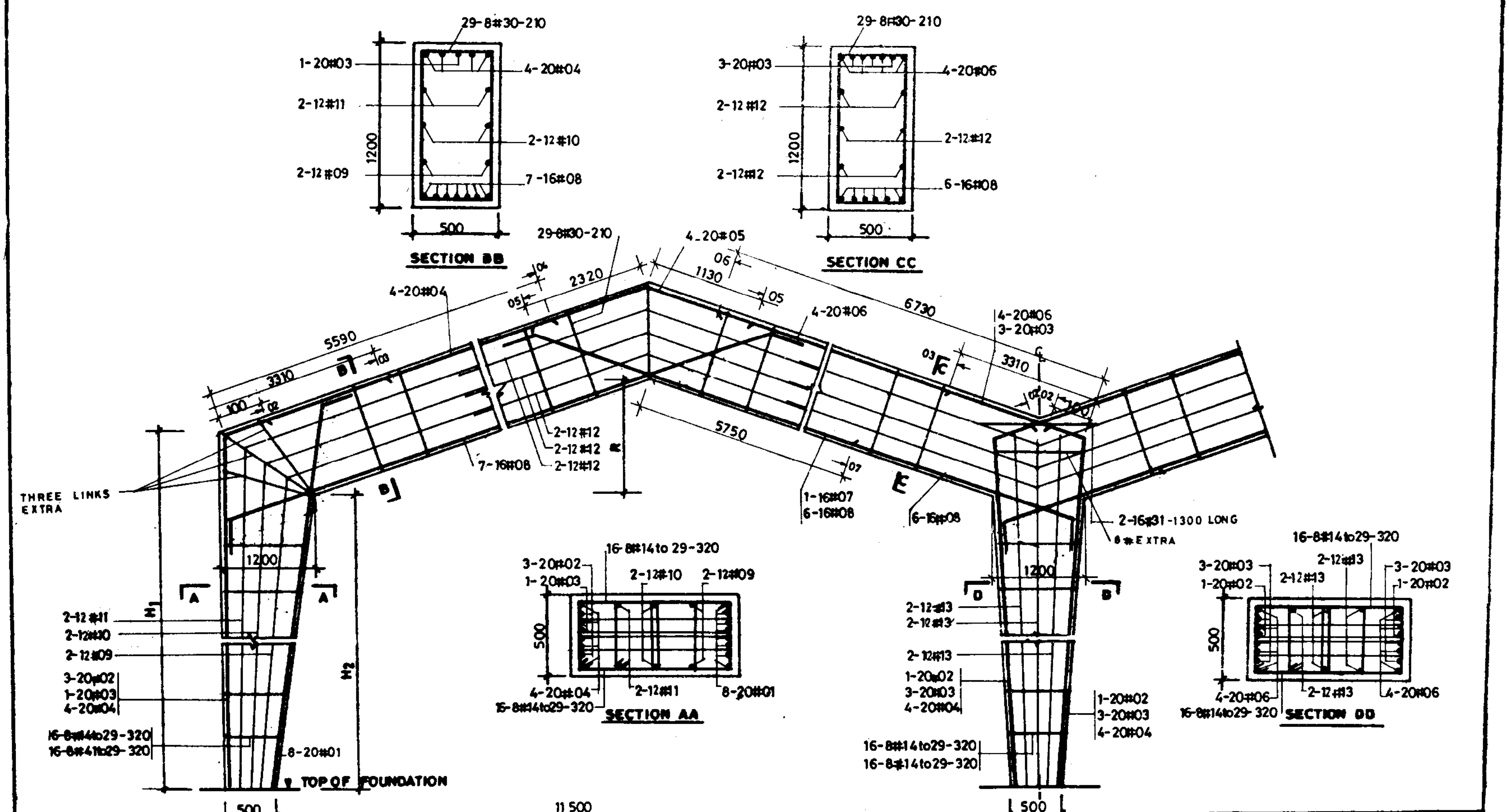
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No OF PURLINS	SPACING	No OF PURLINS	SPACING
1 in 3	6851	6140	1833	6	1285	5	1416
1 in 4	6883	6110	1375	6	1254	5	1381
1 in 5	6903	6090	1100	6	1241	5	1365

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE_103
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360
   c VALLEY : 300

DRAWING No. 103 (REFER TABLE 103)

No. OF BAYS	: TWO
SPAN	: 12.0 m
SPACING	: 12.0 m
COLUMN HEIGHT	: 6.5 m
SUPPORT CONDITION	: HINGED
FOR ALL WIND AND SEISMIC ZONES	
MATERIALS :	
CONCRETE	: M 25
STEEL	: Fe 415



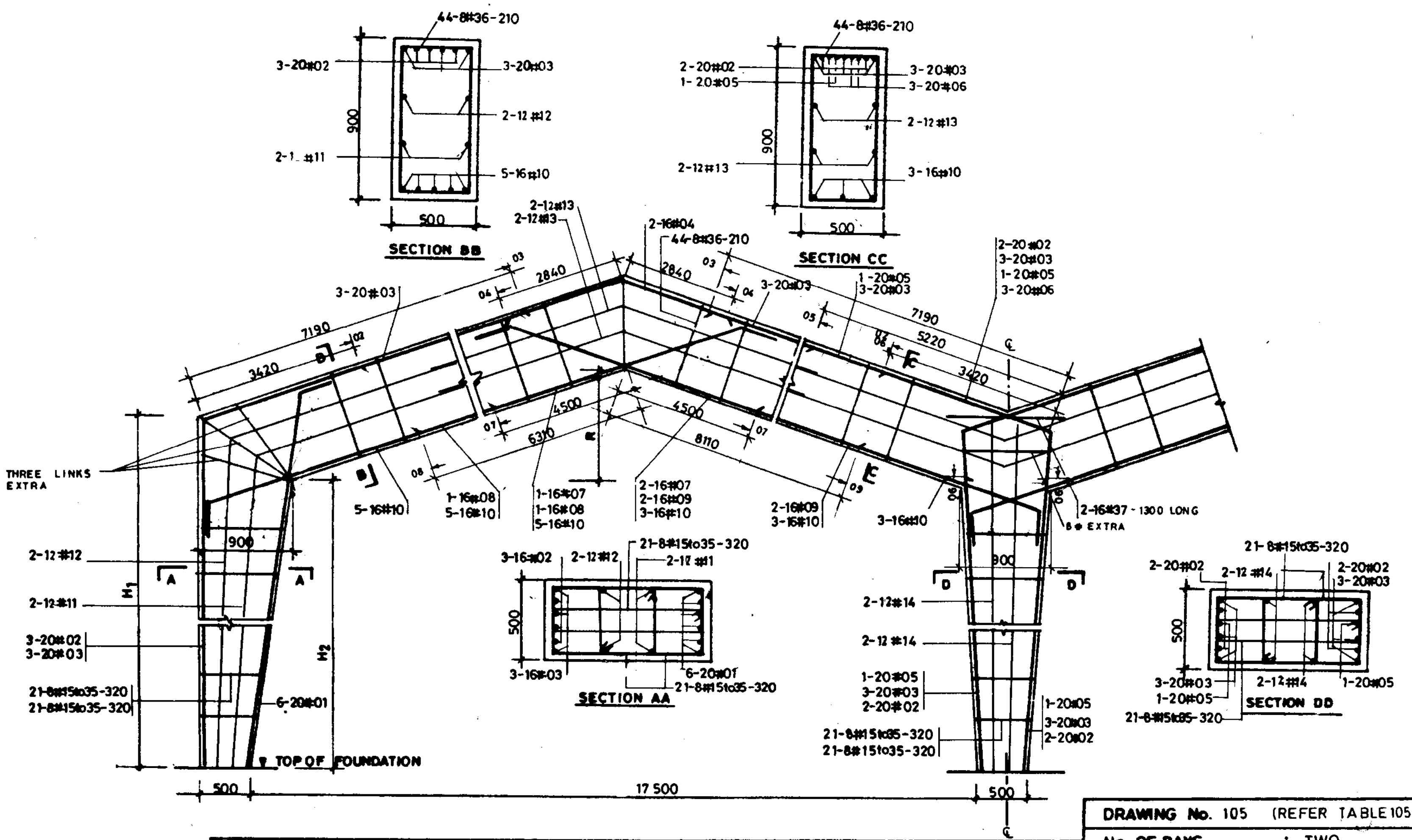
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No OF PURLINS	SPACING	No OF PURLINS	SPACING
1 in 3	9922	9068	1800	6	1306	5	1416
1 in 4	9959	9032	1350	6	1276	5	1381
1 in 5	9984	9008	1080	6	1262	5	1365

NOTE

1. ALL DIMENSIONS ARE IN mm
2 FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE _ 104
3. DISTANCE OF THE NEAREST PURLIN LUG(℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360
   c VALLEY : 300

DRAWING No. 104 (REFER TABLE 104)

No. OF BAYS	: TWO
SPAN	: 12.0 m
SPACING	: 12.0 m
COLUMN HEIGHT	: 9.5 m
SUPPORT CONDITION FOR ALL WIND AND SEISMIC ZONES	: HINGED
MATERIALS :	
CONCRETE	: M25
STEEL	: Fe 415



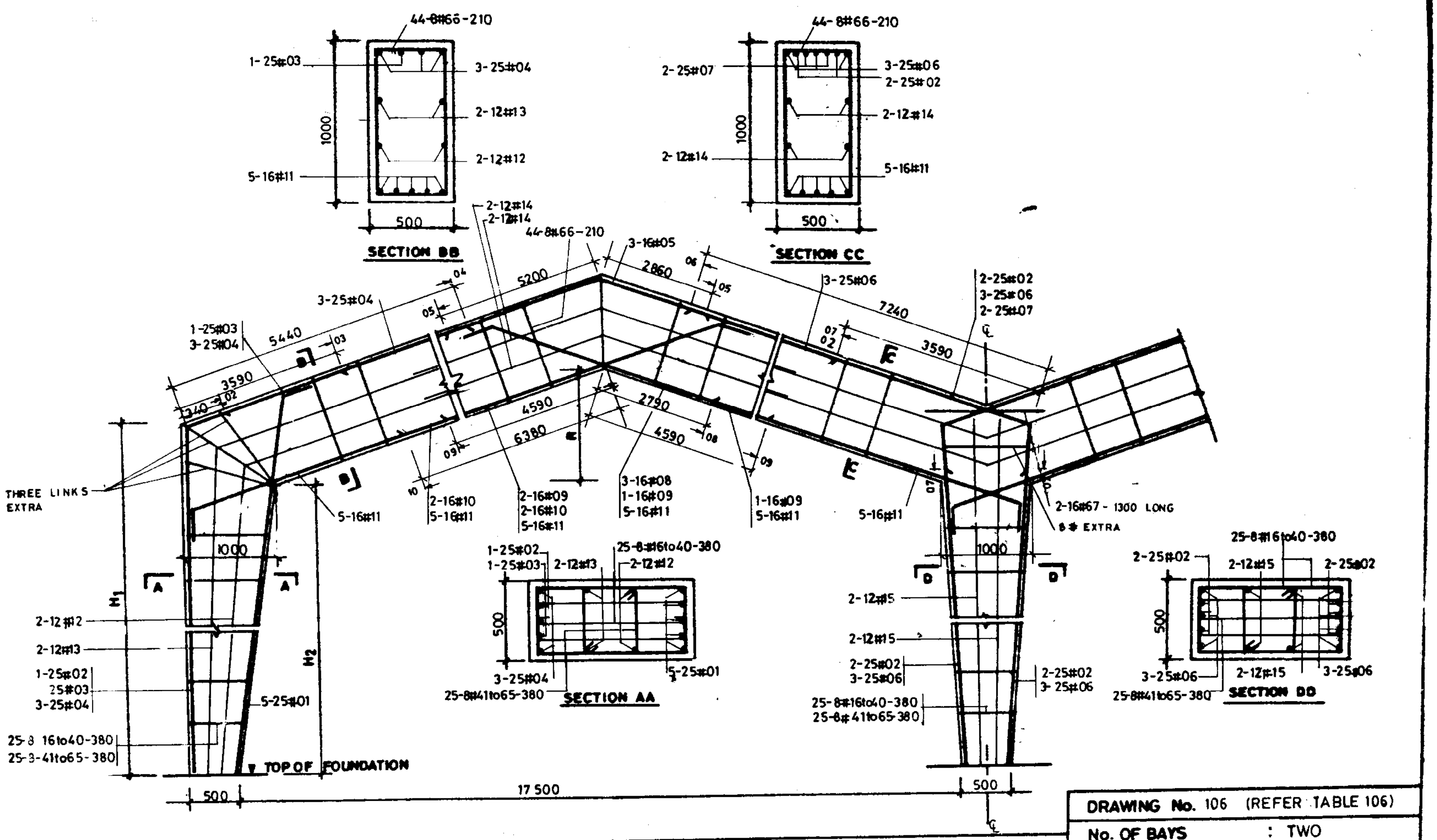
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No OF PURLINS	SPACING	No OF PURLINS	SPACING
1 in 3	6817	6176	2850	8	1369	8	1270
1 in 4	6846	6149	2138	8	1338	8	1240
1 in 5	6864	6131	1710	8	1323	8	1225

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE - 105
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300
   c. VALLEY : 300

DRAWING No. 105 (REFER TABLE 105)

No. OF BAYS : TWO
SPAN : 18.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 6.5 m
SUPPORT CONDITION FOR ALL WIND AND SEISMIC ZONES : HINGED
MATERIALS :
CONCRETE : M25
STEEL : Fe 415



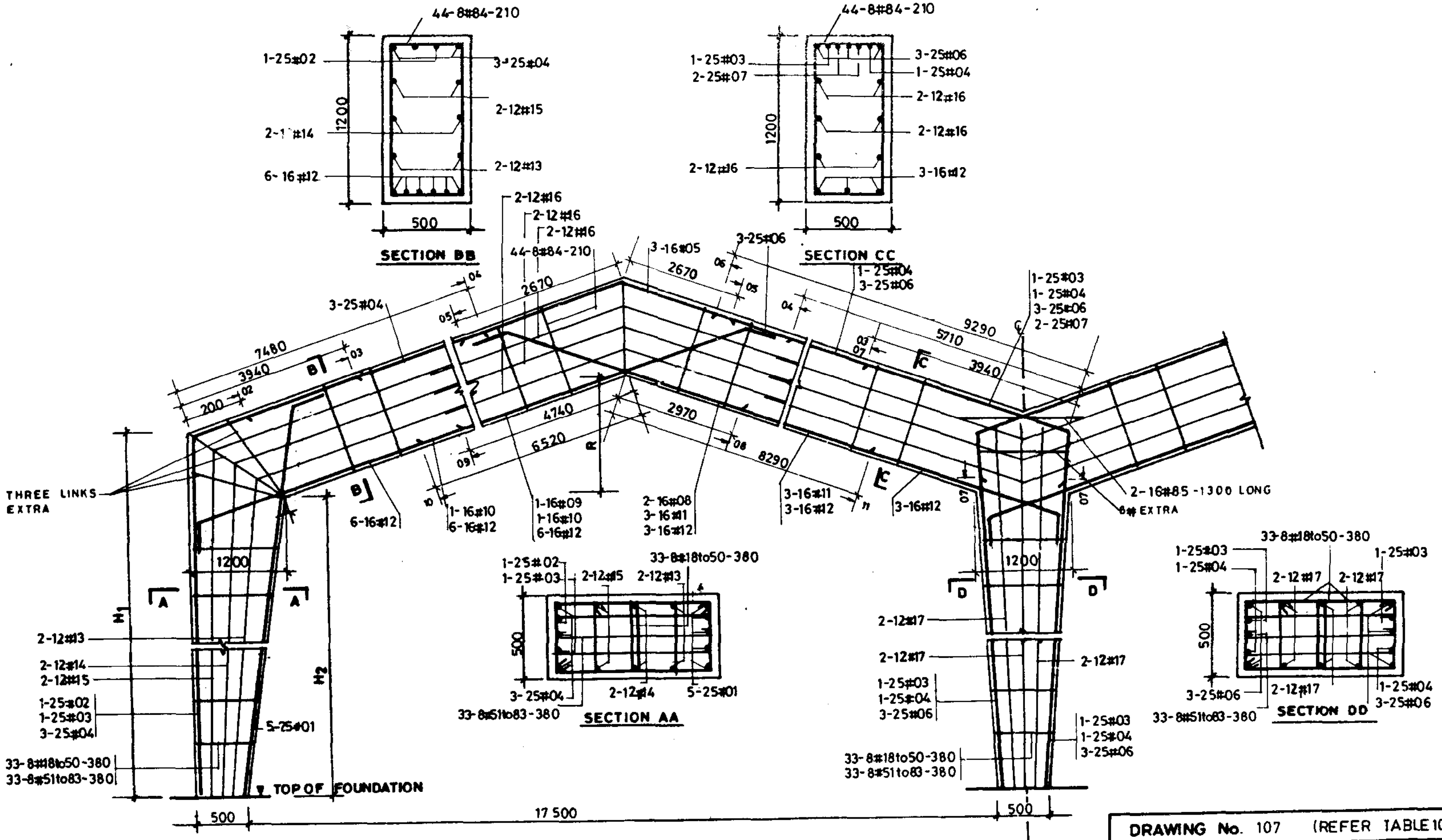
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No OF PURLINS	SPACING	No OF PURLINS	SPACING
1 in 3	9854	9140	2833	8	1376	8	1270
1 in 4	9885	9110	2125	8	1345	8	1240
1 in 5	9905	9090	1700	8	1330	8	1225

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE-106
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300
   c. VALLEY : 300

DRAWING No. 106 (REFER TABLE 106)

No. OF BAYS : TWO
SPAN : 18.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 9.5 m
SUPPORT CONDITION FOR ALL WIND AND SEISMIC ZONES : HINGED
MATERIALS :
CONCRETE : M 25
STEEL : Fe 415



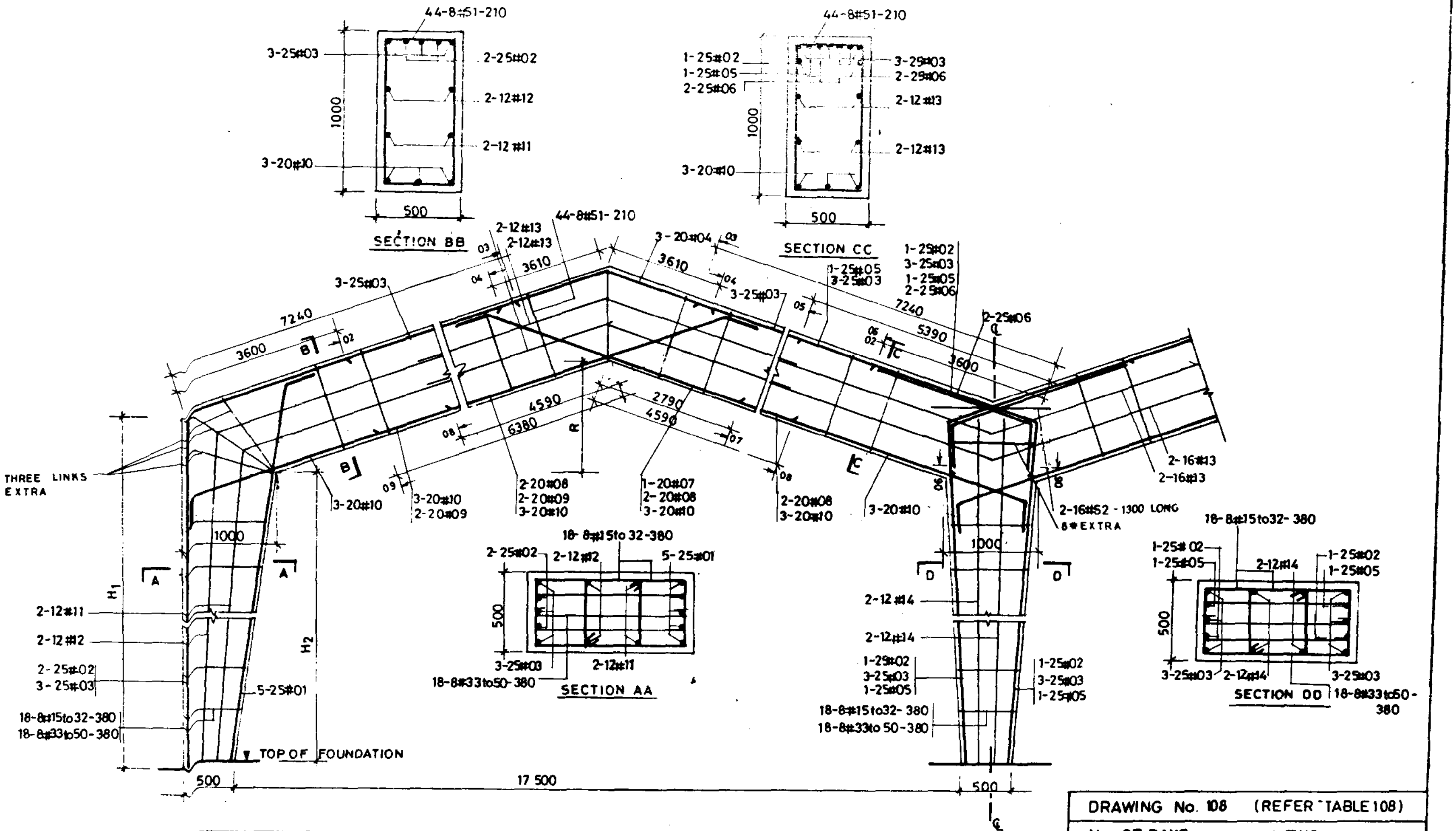
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No OF PURLINS	SPACING	No OF PURLINS	SPACING
1 in 3	12924	12068	2800	8	1392	8	1270
1 in 4	12961	12032	2100	8	1361	8	1240
1 in 5	12986	12008	1680	8	1346	8	1225

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE_107
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   - a. EXTERNAL COLUMN FACE : 100
   - b. RIDGE : 300
   - c VALLEY : 300

DRAWING No. 107 (REFER TABLE 107)

No. OF BAYS : TWO
SPAN : 18.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 12.5 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS :
CONCRETE : M 25
STEEL : Fe 415



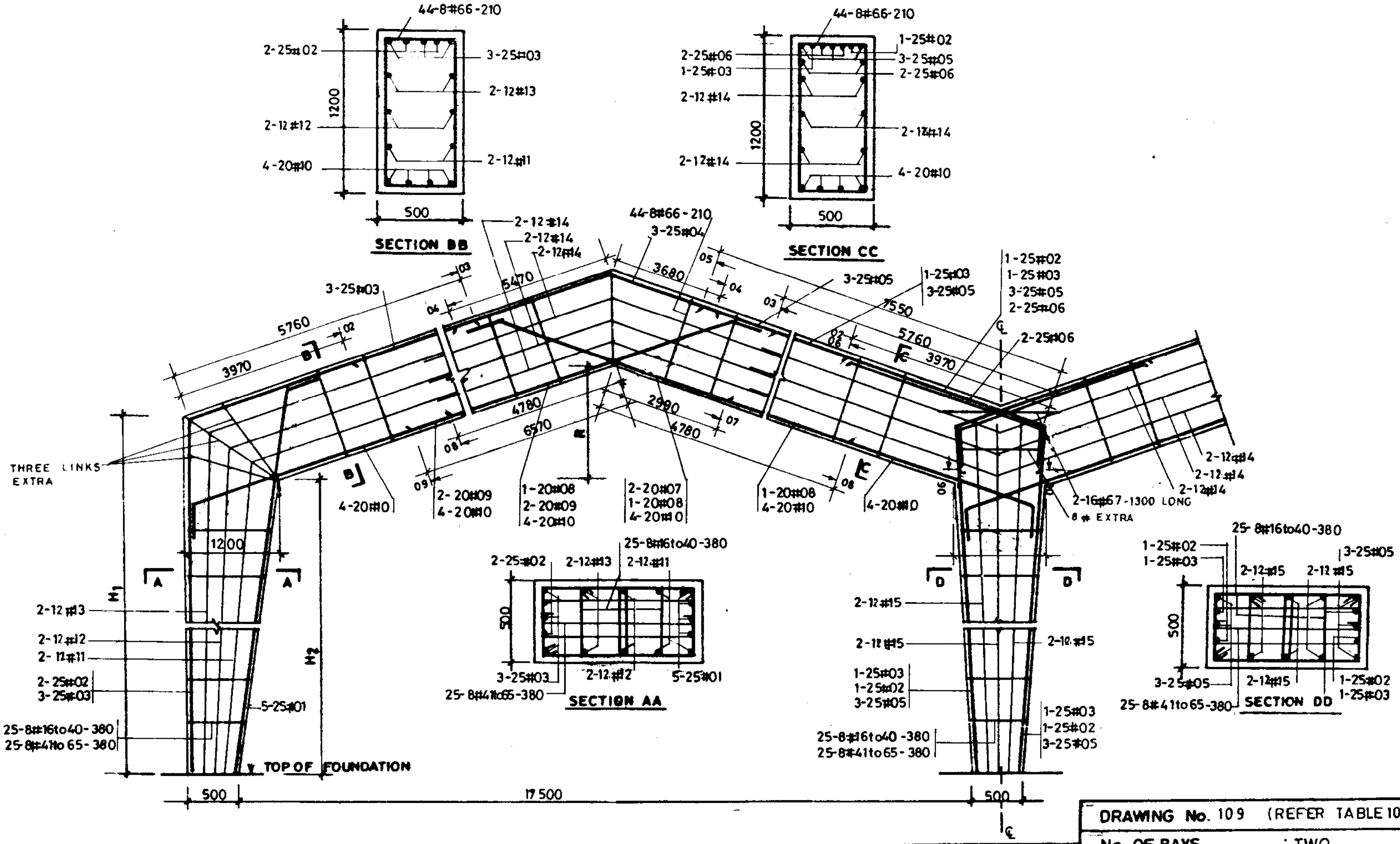
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No OF PURLINS	SPACING	No OF PURLINS	SPACING
1 in 3	6851	6140	2833	8	1369	8	1225
1 in 4	6883	6110	2125	8	1338	7	1395
1 in 5	6903	6090	1700	8	1323	7	1378

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE _ 108
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360
   c. VALLEY : 550

DRAWING No. 108 (REFER TABLE 108)

No. OF BAYS : TWO
SPAN : 18.0 m
SPACING : 12.0 m
COLUMN HEIGHT : 6.5 m
SUPPORT CONDITION FOR ALL WIND AND SEISMIC ZONES : HINGED
MATERIALS :
CONCRETE : M 25
STEEL : Fe 415



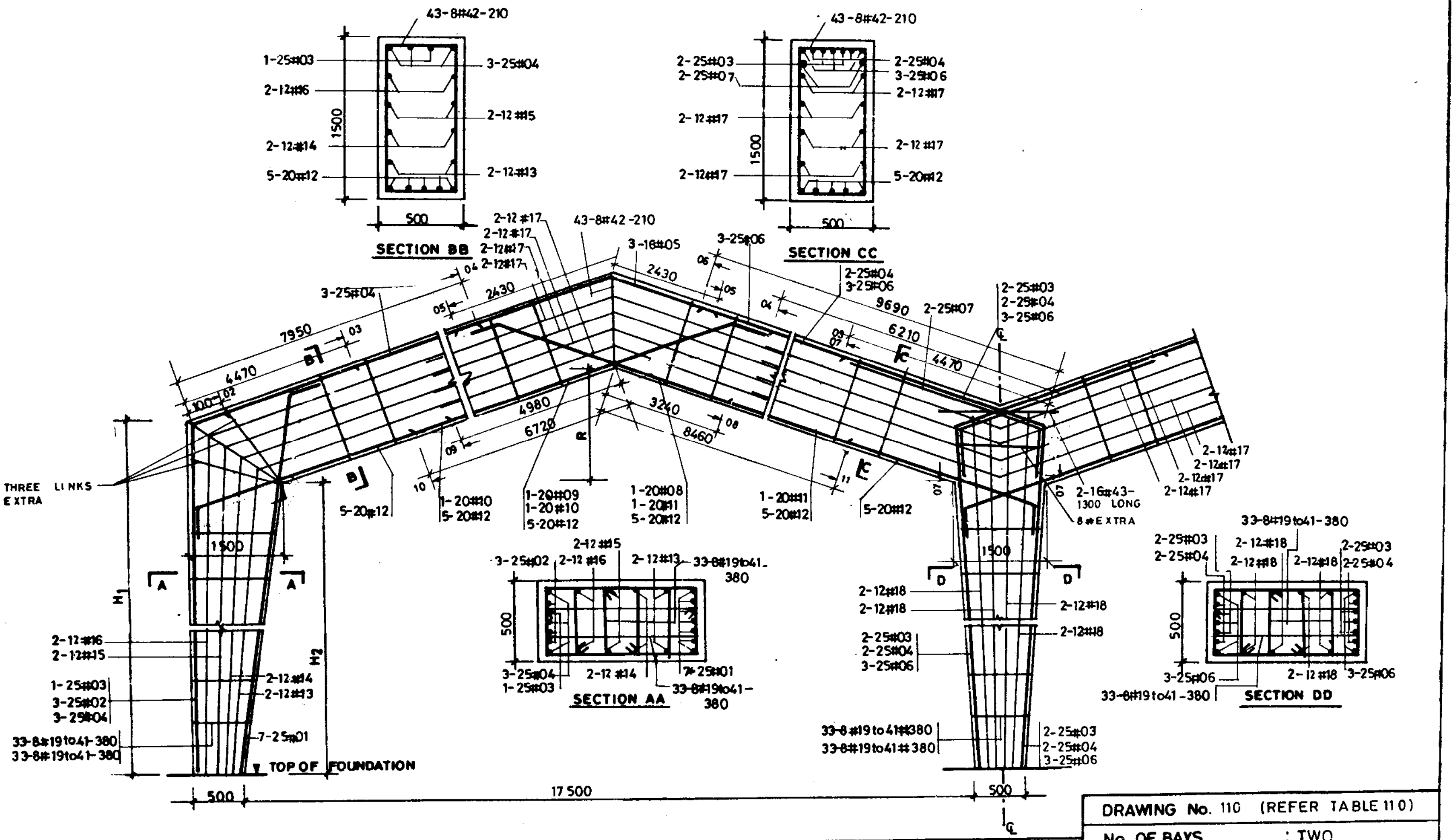
SLOPE	H1	H2	R	NO. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	9922	9068	2800	8	1386	8	1225
1 in 4	9959	9032	2100	8	1353	7	1395
1 in 5	9984	9008	1680	8	1339	7	1378

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE – 109
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360
   c. VALLEY : 550

DRAWING No. 109 (REFER TABLE 109)

No. OF BAYS : TWO
SPAN : 18.0 m
SPACING : 12.0 m
COLUMN HEIGHT : 9.5 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS :
CONCRETE : M25
STEEL : Fe 415



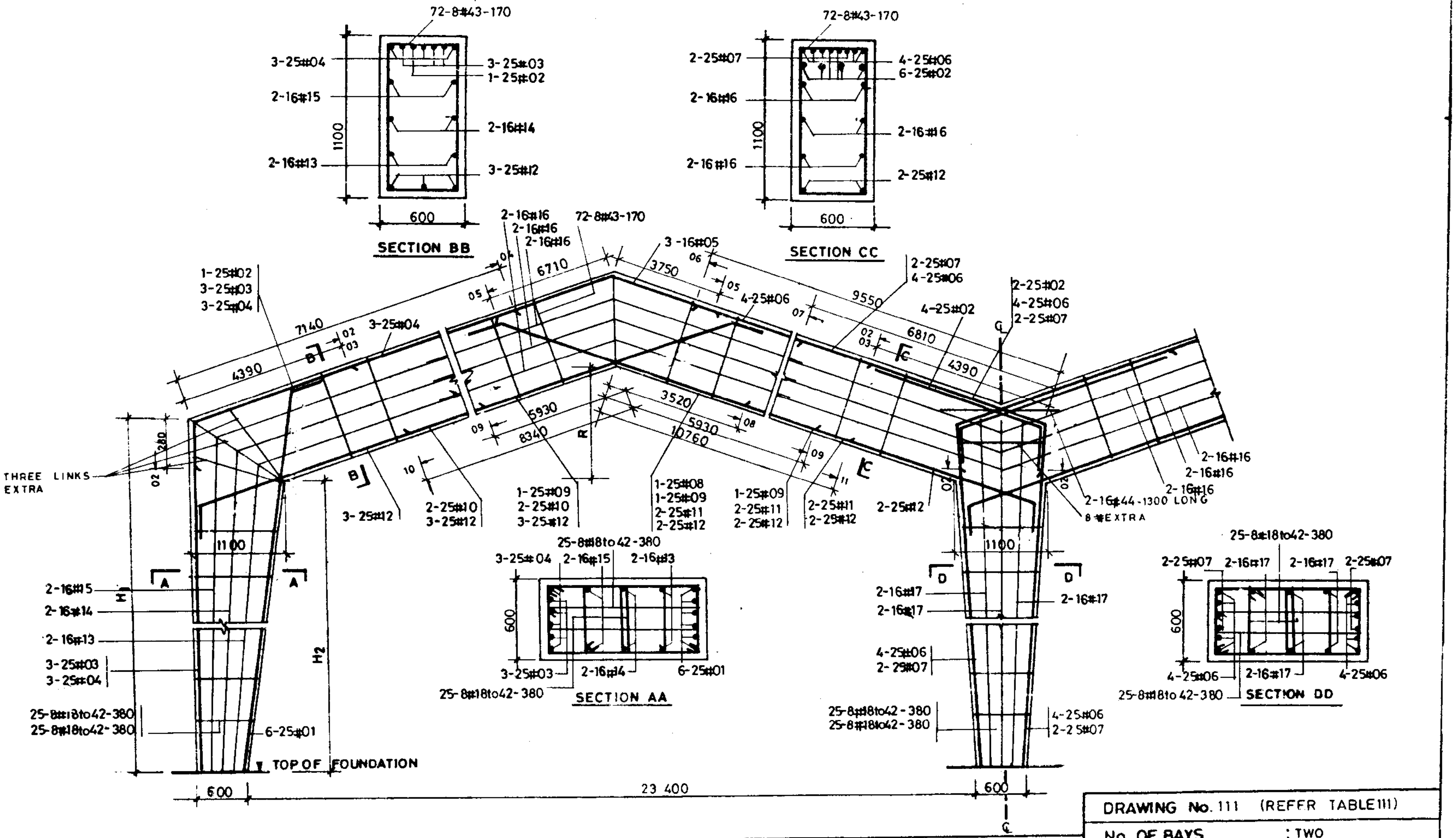
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No OF PURLINS	SPACING	No OF PURLINS	SPACING
1 in 3	13026	11960	2750	8	1409	8	1225
1 in 4	13074	11915	2063	8	1377	7	1395
1 in 5	13105	11885	1650	8	1362	7	1378

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE - 110
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360
   c. VALLEY : 550

DRAWING No. 110 (REFER TABLE 110)

No. OF BAYS : TWO
SPAN : 18.0 m
SPACING : 12.0 m
COLUMN HEIGHT : 12.5 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS :
CONCRETE : M25
STEEL : Fe 415



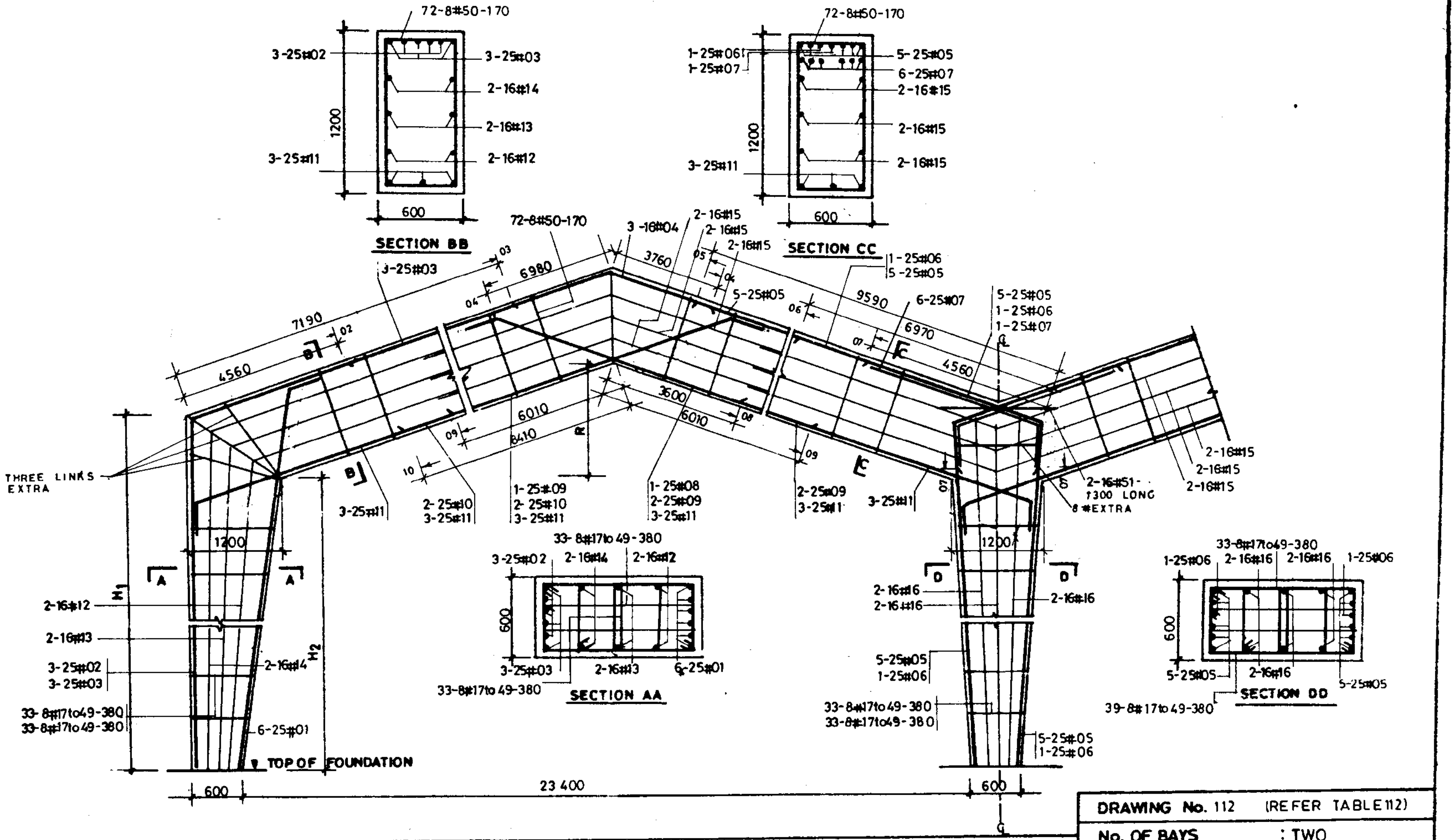
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No OF PURLINS	SPACING	No OF PURLINS	SPACING
1 in 3	9889	9104	3817	11	1285	10	1311
1 in 4	9924	9071	2863	10	1396	10	1280
1 in 5	9946	9049	2290	10	1380	10	1265

NOTE

1. ALL DIMENSIONS ARE IN mm
2 FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE -111
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300
   c VALLEY : 550

DRAWING No. 111 (REFER TABLE111)

No. OF BAYS	: TWO
SPAN	: 24.0 m
SPACING	: 6.0 m
COLUMN HEIGHT	: 9.5 m
SUPPORT CONDITION FOR ALL WIND AND SEISMIC ZONES	: HINGED
MATERIALS :	
CONCRETE	: M25
STEEL	: Fe 415



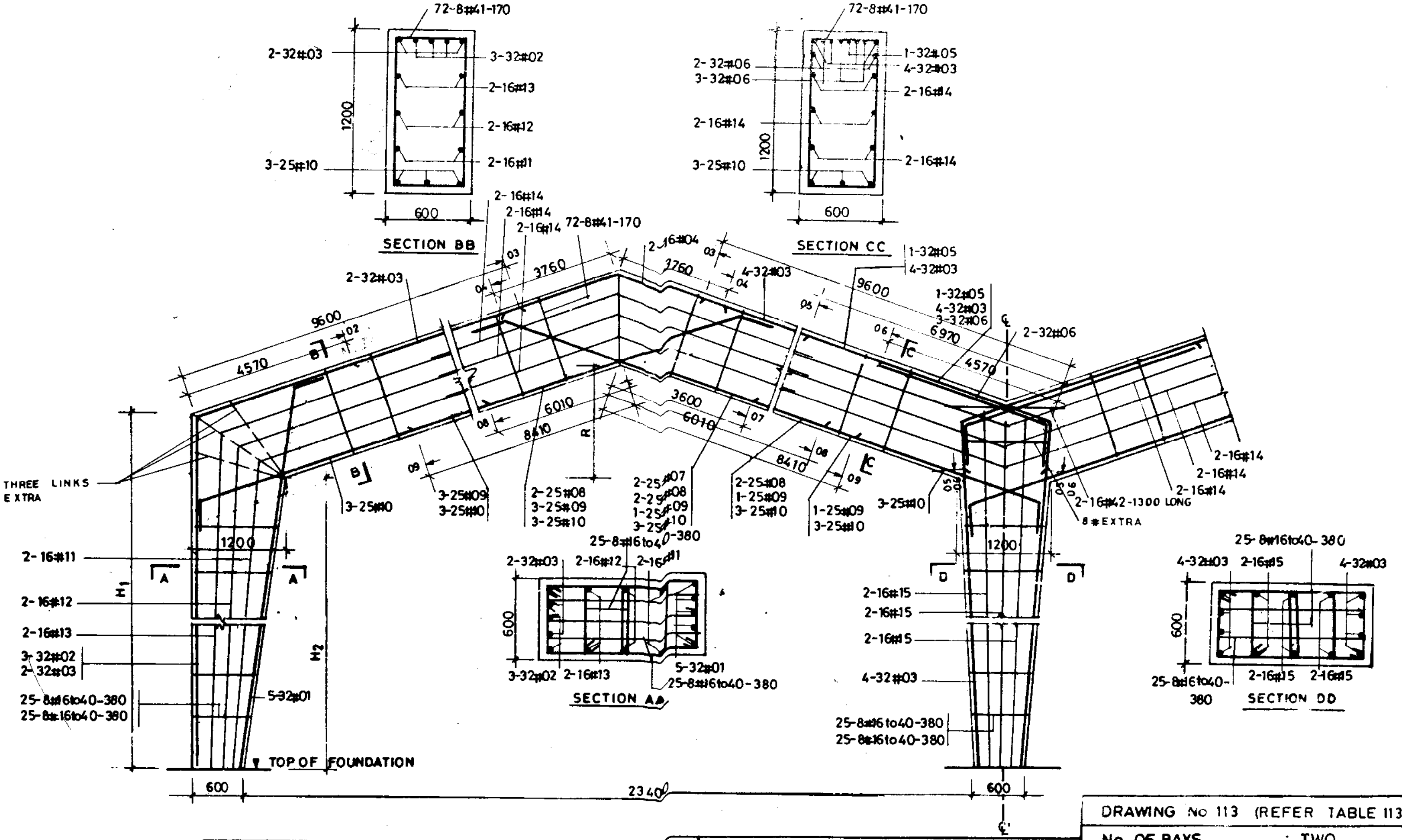
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	12925	12068	3800	11	1290	10	1311
1 in 4	12963	12032	2850	10	1401	10	1280
1 in 5	12987	12008	2280	10	1386	10	1265

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE 112
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   - a. EXTERNAL COLUMN FACE : 100
   - b. RIDGE : 300
   - c. VALLEY : 550

DRAWING No. 112 (REFER TABLE 112)

No. OF BAYS : TWO
SPAN : 24.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 12.5 m
SUPPORT CONDITION FOR ALL WIND AND SEISMIC ZONES : HINGED
MATERIALS :
CONCRETE : M25
STEEL : Fe 415



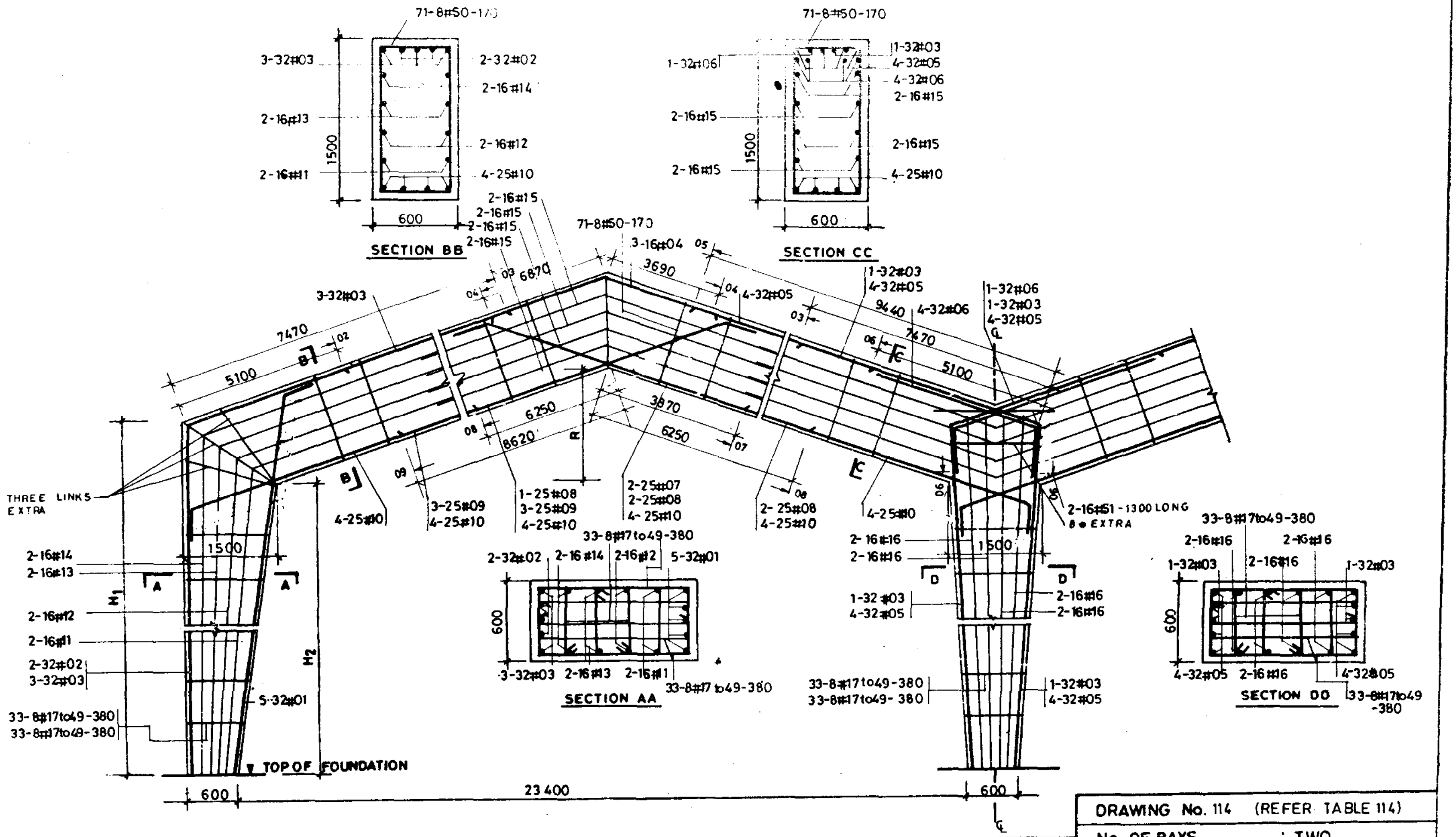
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No OF PURLINS	SPACING	No OF PURLINS	SPACING
1 in 3	9923	9068	3800	11	1285	10	1304
1 in 4	9961	9032	2850	10	1396	10	1273
1 in 5	9985	9008	2280	10	1380	10	1259

NOTE

1. ALL DIMENSIONS ARE IN mm.
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE – 113
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   - a. EXTERNAL COLUMN FACE : 100
   - b. RIDGE : 360
   - c. VALLEY : 550

DRAWING No 113 (REFER TABLE 113)

No. OF BAYS : TWO
SPAN : 24.0 m
SPACING 12.0 m
COLUMN HEIGHT 9.5 m
SUPPORT CONDITION FOR ALL WIND AND SEISMIC ZONES : HINGED
MATERIALS :
CONCRETE : M25
STEEL : Fe415



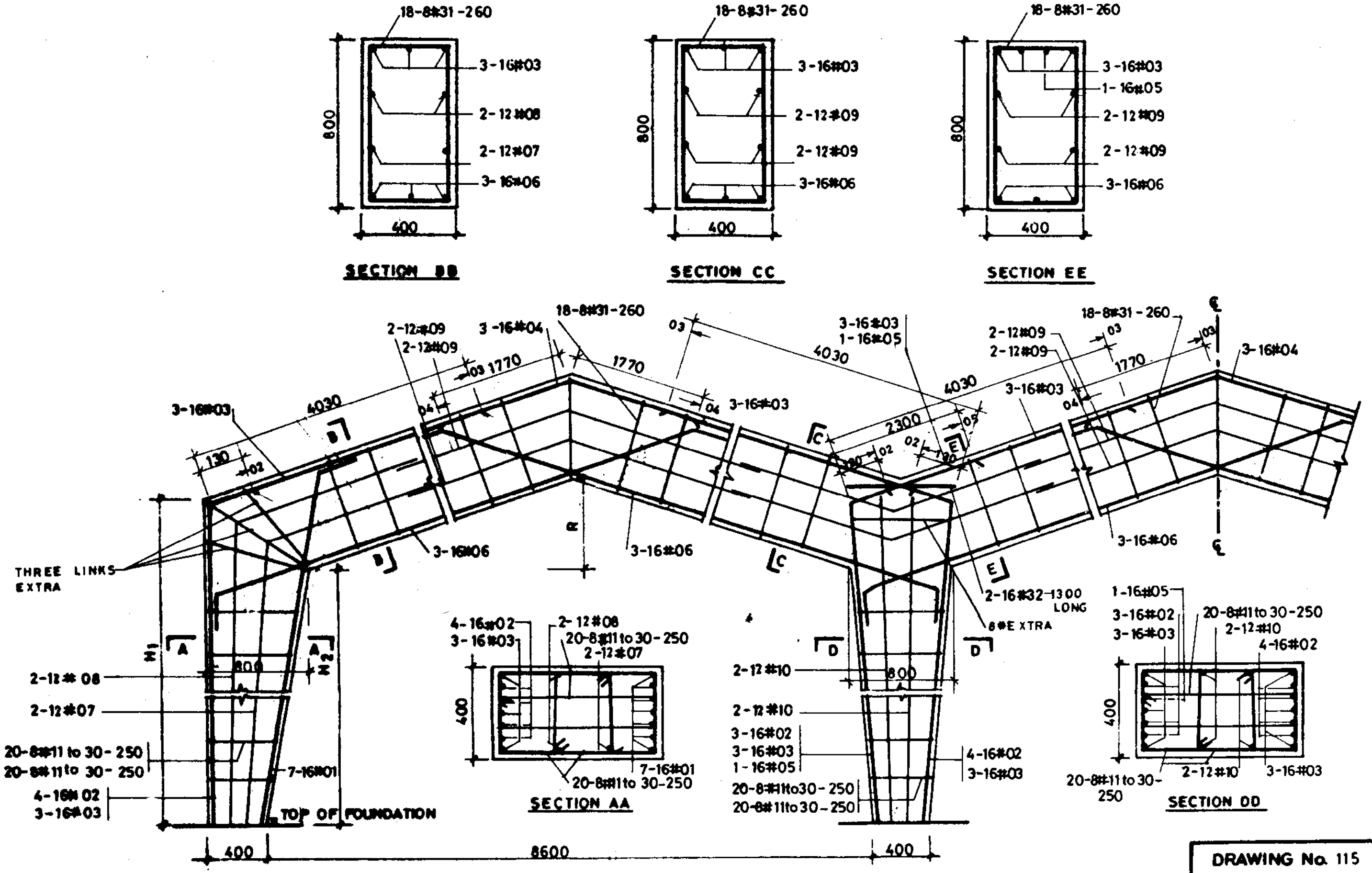
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No OF PURLINS	SPACING	No OF PURLINS	SPACING
1 in 3	13027	11960	3750	11	1302	10	1304
1 in 4	13075	11915	2813	10	1414	10	1273
1 in 5	13106	11885	2250	10	1399	10	1259

NOTE

1. ALL DIMENSIONS ARE IN mm
2 FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE-114
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360
   c VALLEY : 550

DRAWING No. 114 (REFER TABLE 114)

No. OF BAYS : TWO
SPAN : 24.0 m
SPACING : 12.0 m
COLUMN HEIGHT : 12.5 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS :
CONCRETE : M25
STEEL : Fe415



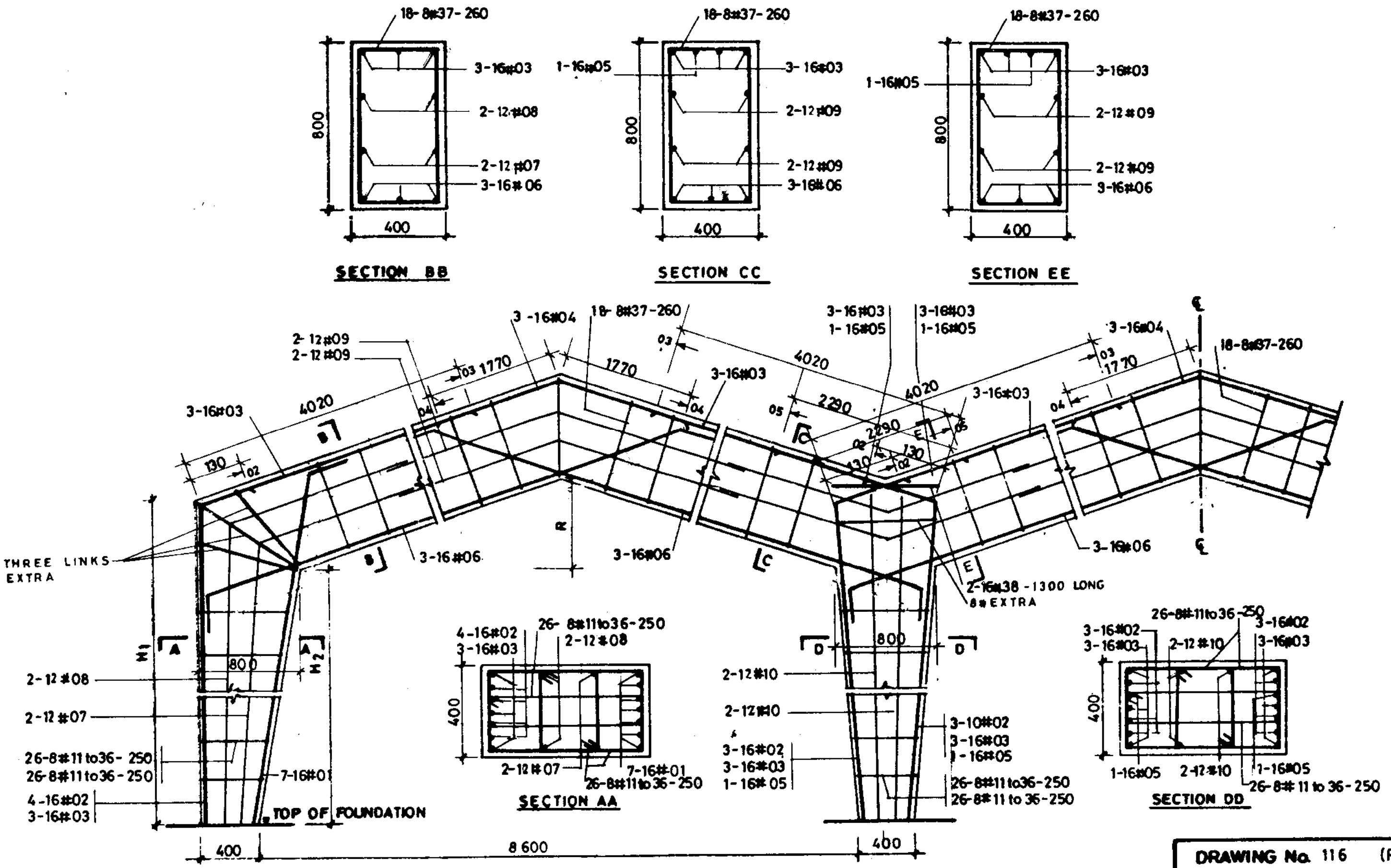
SLOPE	H1	H2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	5280	4712	1367	5	1198	4	1381
1 in 4	5306	4688	1025	5	1170	4	1346
1 in 5	5322	4672	820	5	1156	4	1330

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE_115
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300
   c. VALLEY : 300

DRAWING No. 115 (REFER TABLE 115)

No. OF BAYS : THREE
SPAN : 9.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 5.0 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS :
CONCRETE : M25
STEEL : Fe 415



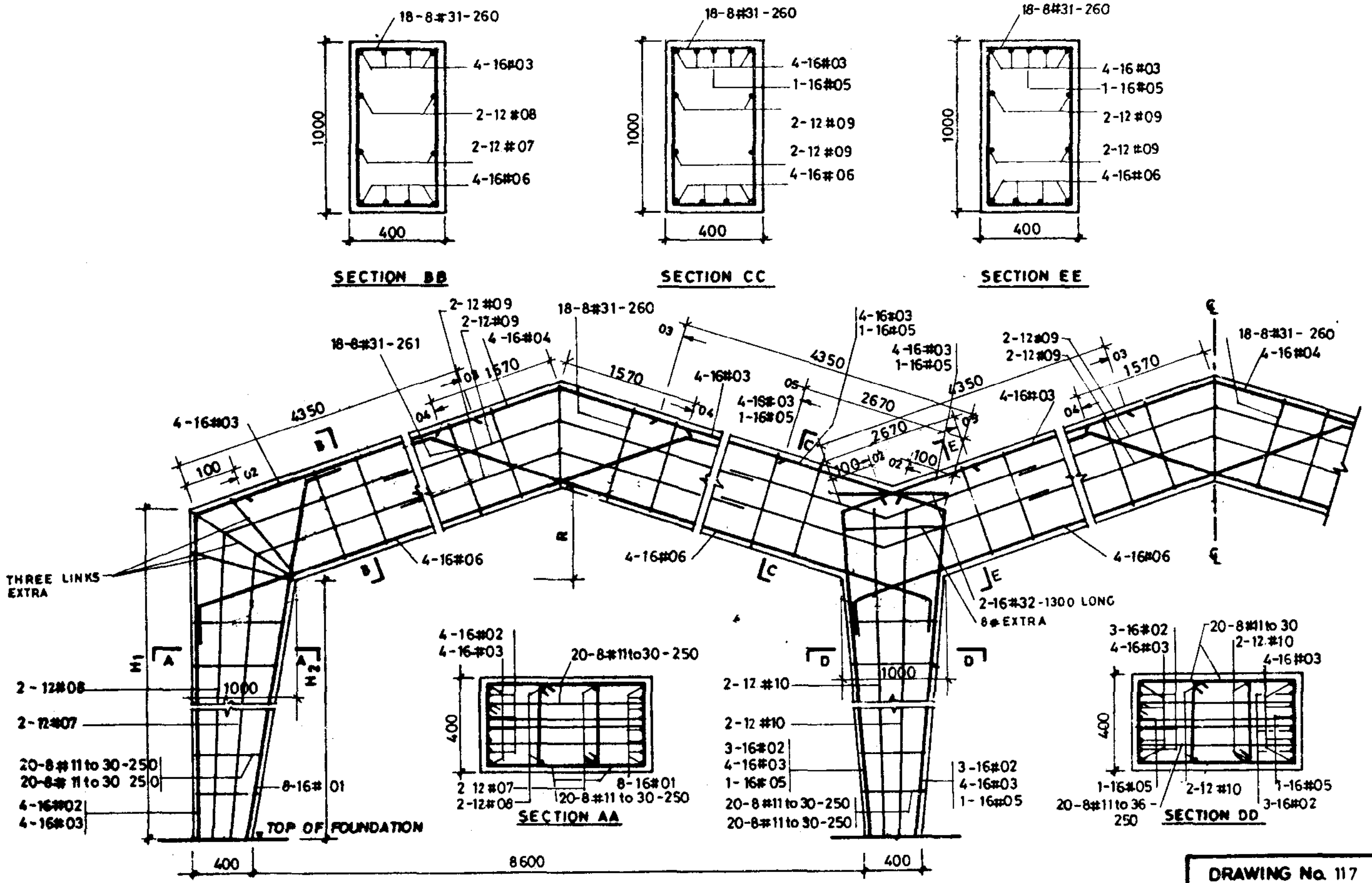
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	6782	6212	1367	5	1197	4	1381
1 in 4	6807	6188	1025	5	1168	4	1346
1 in 5	6824	6172	820	5	1155	4	1330

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE 116
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300
   c. VALLEY : 300

DRAWING No. 116 (REFER TABLE 116)

No. OF BAYS	: THREE
SPAN	: 9.0 m
SPACING	: 6.0 m
COLUMN HEIGHT	: 6.5 m
SUPPORT CONDITION	: HINGED
FOR ALL WIND AND SEISMIC ZONES	
MATERIALS :	
CONCRETE	: M25
STEEL	: Fe 415



SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	5345	4640	1333	5	1215	4	1361
1 in 4	5378	4610	1000	5	1186	4	1326
1 in 5	5399	4590	800	5	1173	4	1310

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE-117
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360
   c. VALLEY : 300

DRAWING No. 117 (REFER TABLE 117)

No. OF BAYS : THREE
SPAN : 9.0 m
SPACING : 12.0 m
COLUMN HEIGHT : 5.0 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS :
CONCRETE : **M25**
STEEL : **Fe 415**

SLOPE	H_1	H_2	R	EXTERIOR RAFTER No. OF PURLINS	EXTERIOR RAFTER SPACING	INTERIOR RAFTER No. OF PURLINS	INTERIOR RAFTER SPACING
1 in 5	6902	6090	800	5	1170	4	1310
[illegible]	6845	6140	1333	5	1212	4	1361

NO. AND SPACING OF PURLINS

NOTE

1. ALL DIMENSIONS ARE IN mm

2 FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE_118

3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE : 100

b. RIDGE : 360

c. VALLEY : 300

FOR ALL WIND AND SEISMIC ZONES

MATERIALS :

CONCRETE : M20

STEEL : Fe 415

COLUMN HEIGHT : 6.5 m

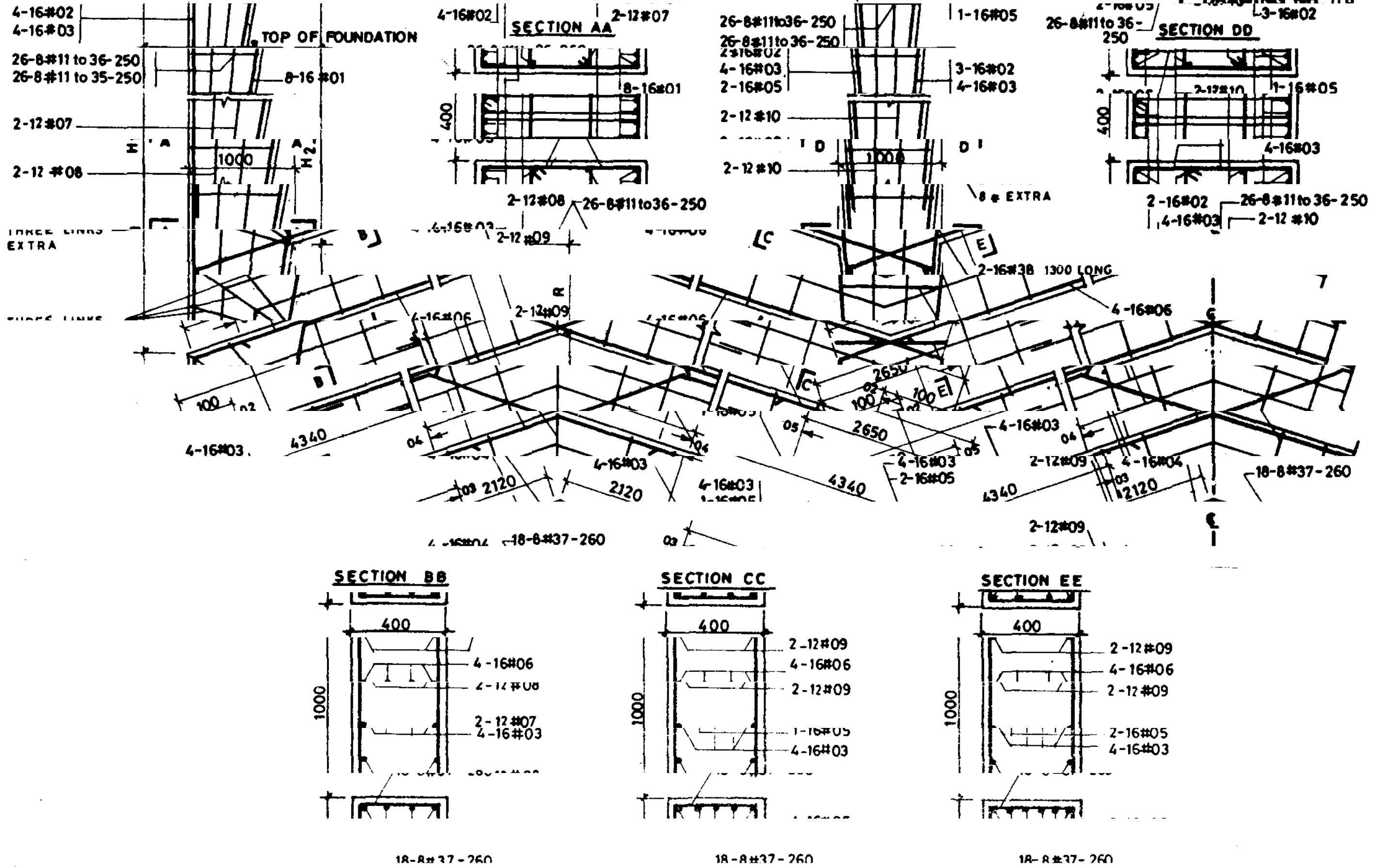
SUPPORT CONDITION : HINGED

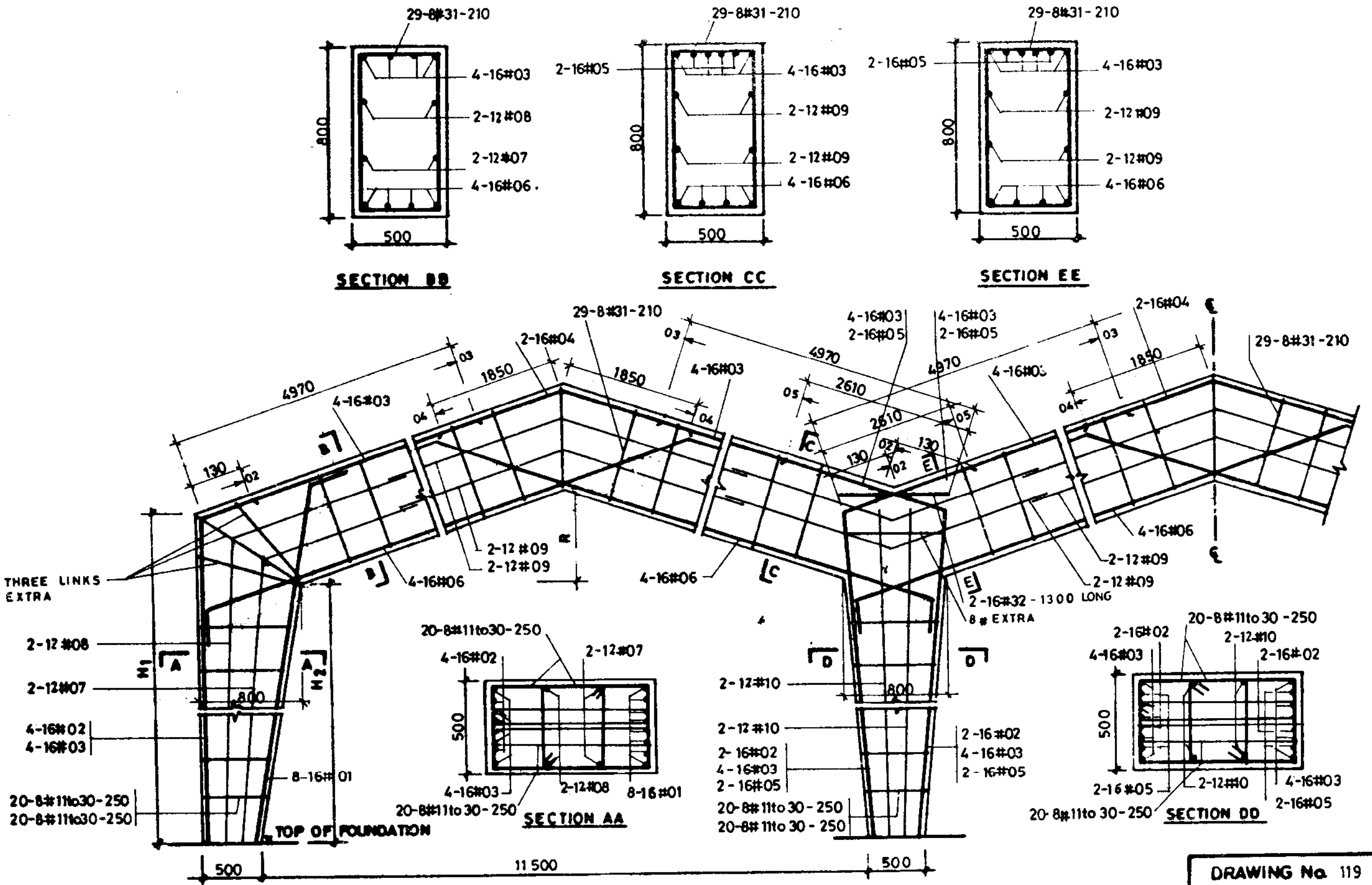
SPAN : 9.0 m

SPACING : 12.0 m

No. OF BAYS : THREE

DRAWING No. 118 (REFER TABLE 118)





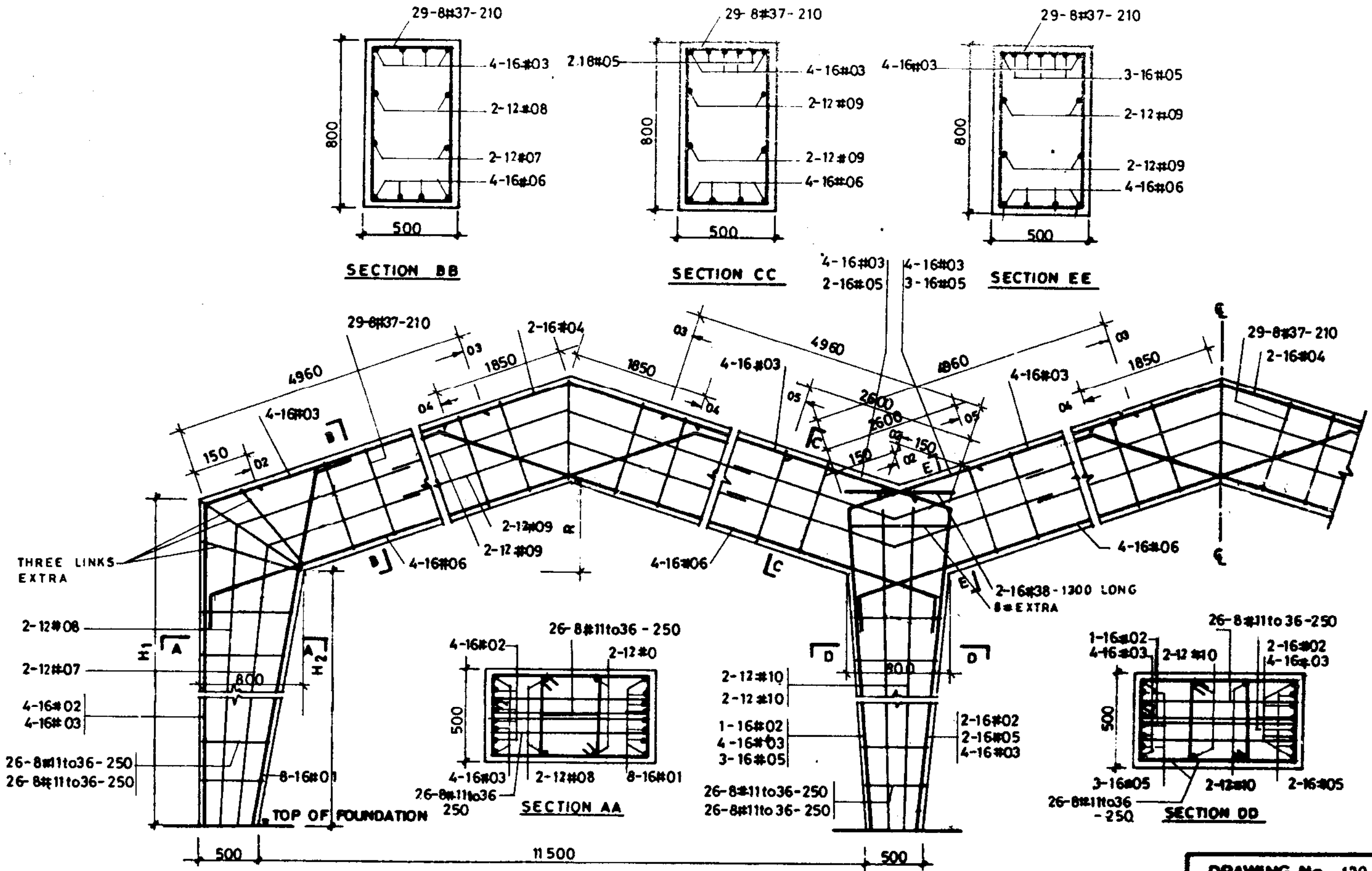
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	5282	4712	1867	6	1273	6	1145
1 in 4	5307	4688	1400	6	1243	5	1396
1 in 5	5324	4672	1120	6	1230	5	1380

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE _119
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300
   c. VALLEY : 300

DRAWING No. 119 (REFER TABLE 119)

No. OF BAYS : THREE
SPAN : 12.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 5.0 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS :
CONCRETE : M25
STEEL : Fe 415



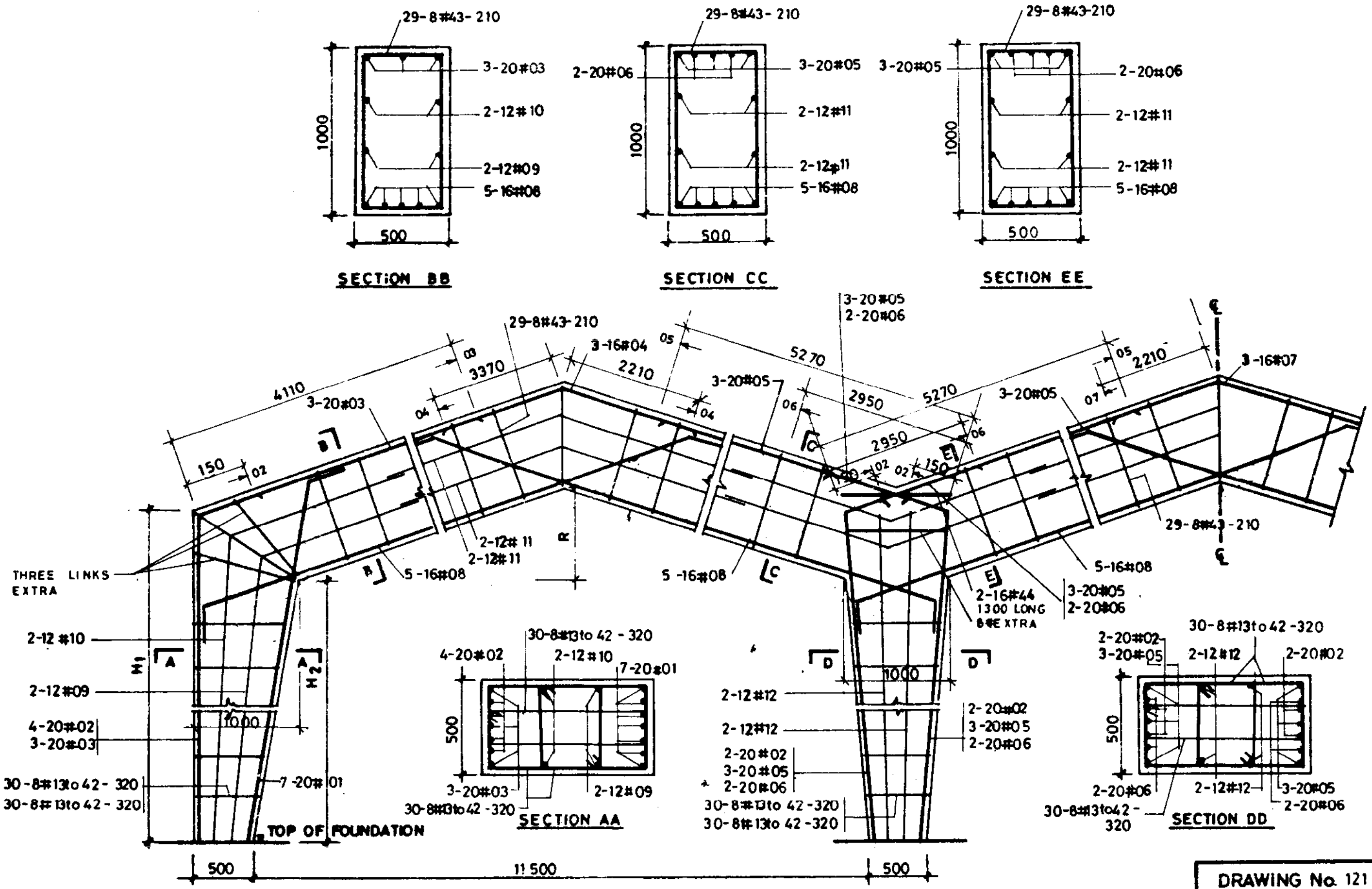
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	6784	6212	1867	6	1272	6	1145
1 in 4	6809	6188	1400	6	1243	5	1396
1 in 5	6825	6172	1120	6	1229	5	1380

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE_120
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300
   c. VALLEY : 300

DRAWING No. 120 (REFER TABLE 120)

No. OF BAYS : THREE
SPAN : 12.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 6.5 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS :
CONCRETE : M25
STEEL : Fe 415



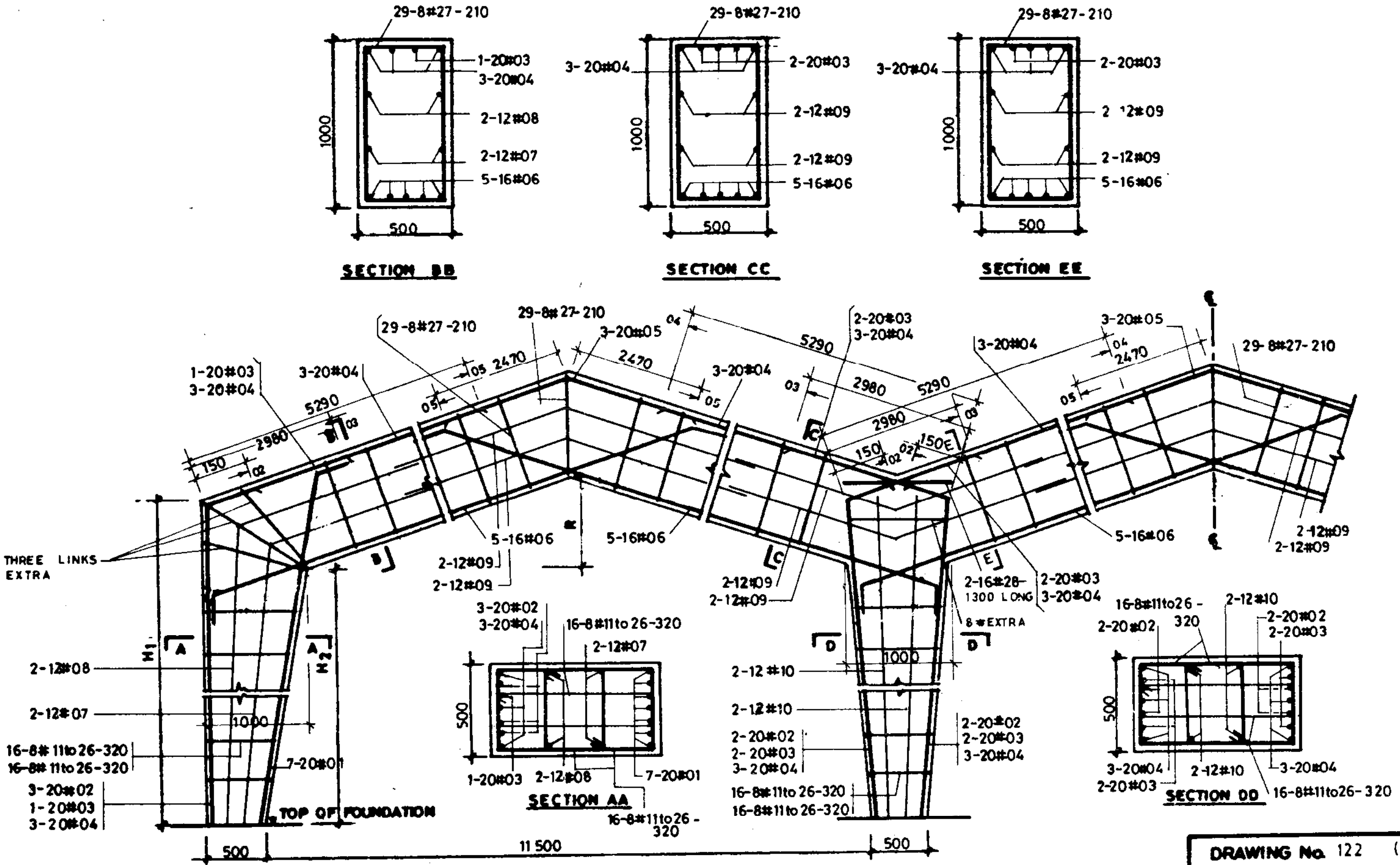
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	9854	9140	1833	6	1295	6	1145
1 in 4	9885	9110	1375	6	1264	5	1396
1 in 5	9906	9090	1100	6	1250	5	1380

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE_121
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   - a. EXTERNAL COLUMN FACE : 100
   - b. RIDGE : 300
   - c. VALLEY : 300

DRAWING No. 121 (REFER TABLE 121)

No. OF BAYS : THREE
SPAN : 12.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 9.5 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS :
CONCRETE : M25
STEEL : Fe 415



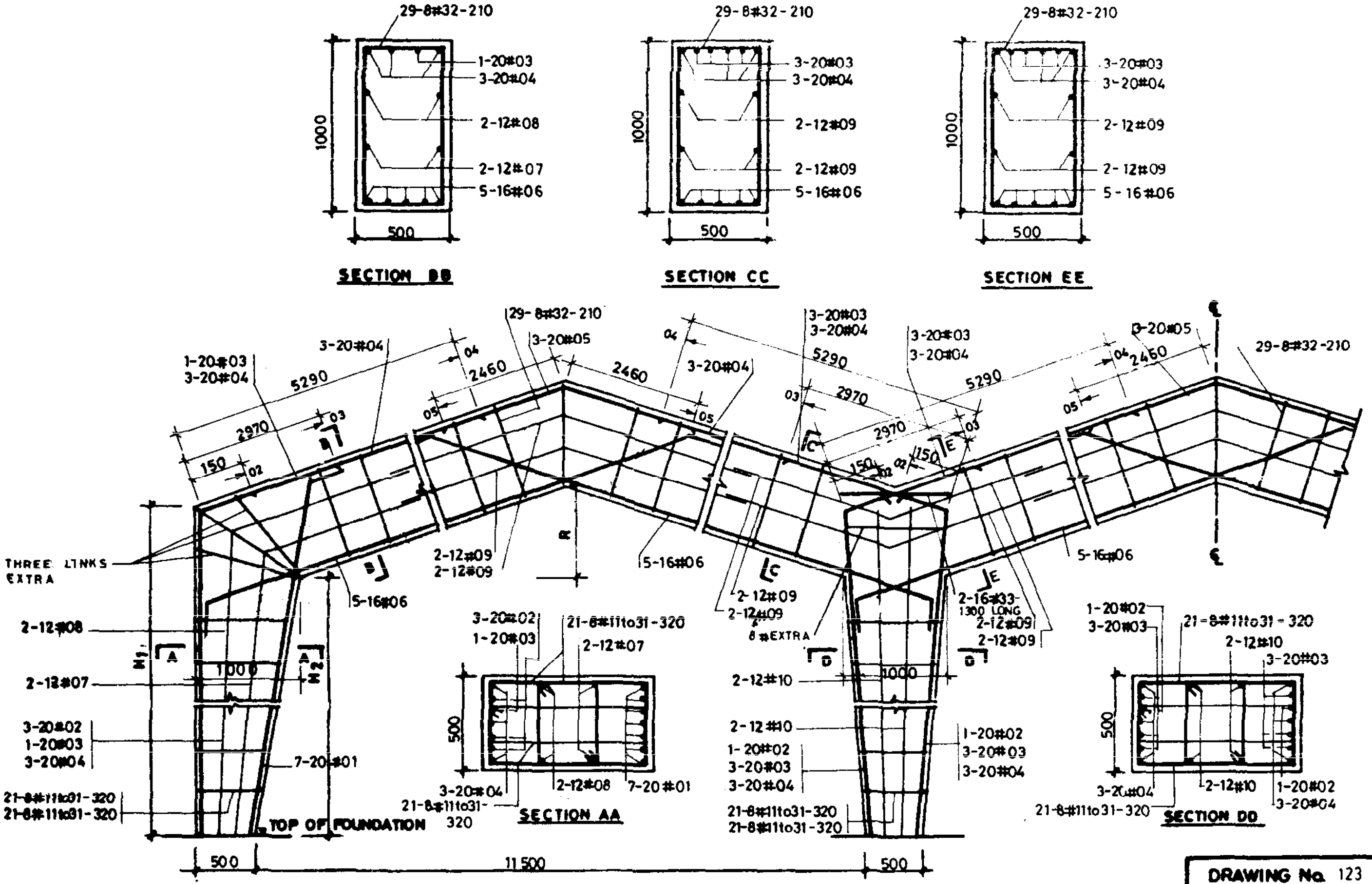
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	5348	4640	1833	6	1287	5	1416
1 in 4	5380	4610	1375	6	1257	5	1381
1 in 5	5402	4590	1100	6	1243	5	1365

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE _ 122
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360
   c. VALLEY : 300

DRAWING No. 122 (REFER TABLE 122)

No. OF BAYS : THREE
SPAN : 12.0 m
SPACING : 12.0 m
COLUMN HEIGHT : 5.0 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS :
CONCRETE : M25
STEEL : Fe 415



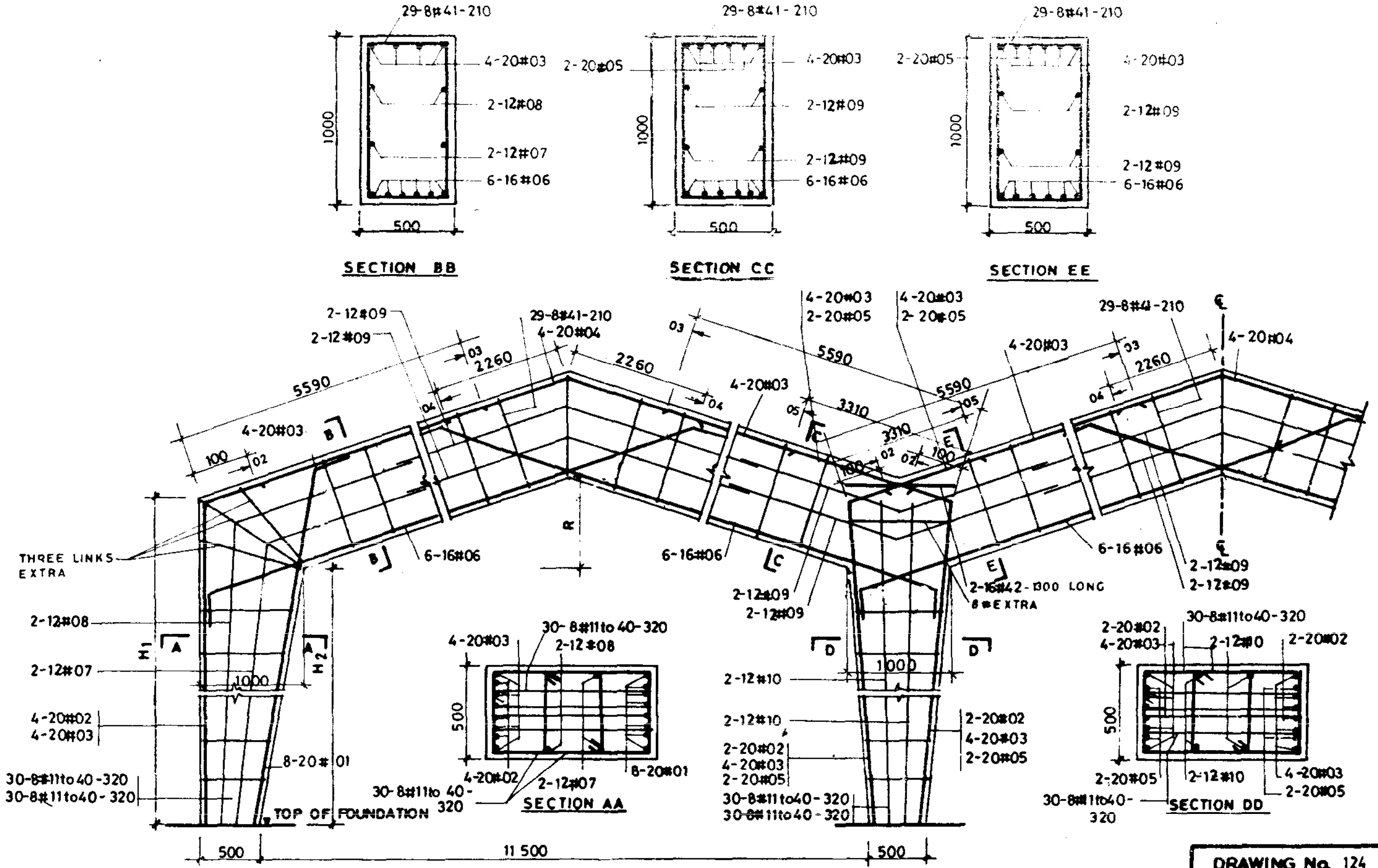
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	6851	6140	1833	6	1285	5	1416
1 in 4	6883	6110	1375	6	1254	5	1381
1 in 5	6903	6090	1100	6	1241	5	1365

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE - 123
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360
   c. VALLEY : 300

DRAWING No. 123 (REFER TABLE 123)

No. OF BAYS	: THREE
SPAN	: 12.0 m
SPACING	: 12.0 m
COLUMN HEIGHT	: 6.5 m
SUPPORT CONDITION	: HINGED
FOR ALL WIND AND SEISMIC ZONES	
MATERIALS :	
CONCRETE	: **M25**
STEEL	: **Fe 415**



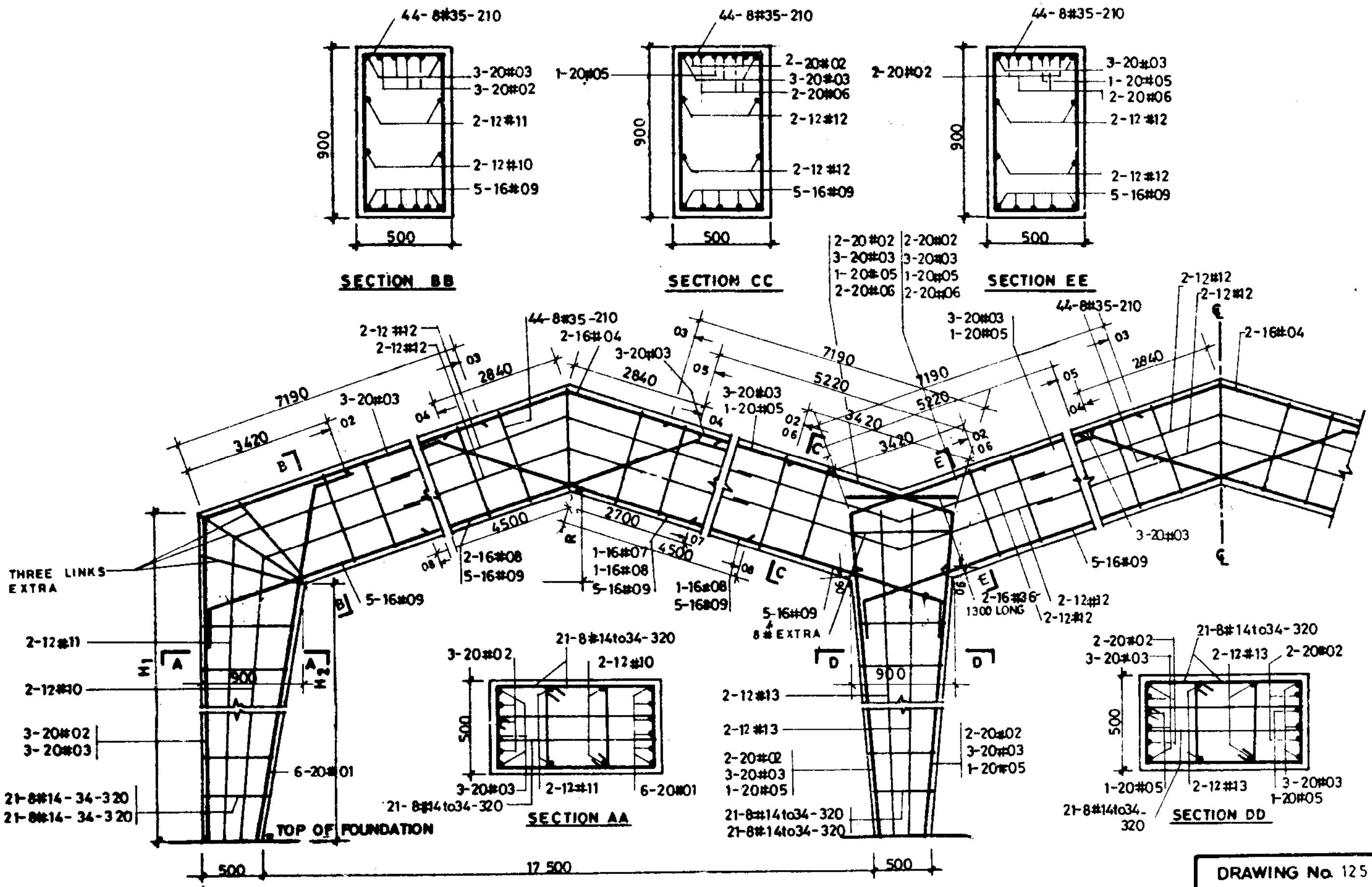
SLOPE	HH_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	9922	9068	1800	6	1306	5	1416
1 in 4	9959	9032	1350	6	1276	5	1381
1 in 5	9984	9008	1080	6	1262	5	1365

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE_124
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   - a. EXTERNAL COLUMN FACE : 100
   - b. RIDGE : 360
   - c. VALLEY : 300

DRAWING No. 124 (REFER TABLE 124)

No. OF BAYS : THREE
SPAN : 12.0 m
SPACING : 12.0 m
COLUMN HEIGHT : 9.5 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS
CONCRETE : M25
STEEL : Fe 415



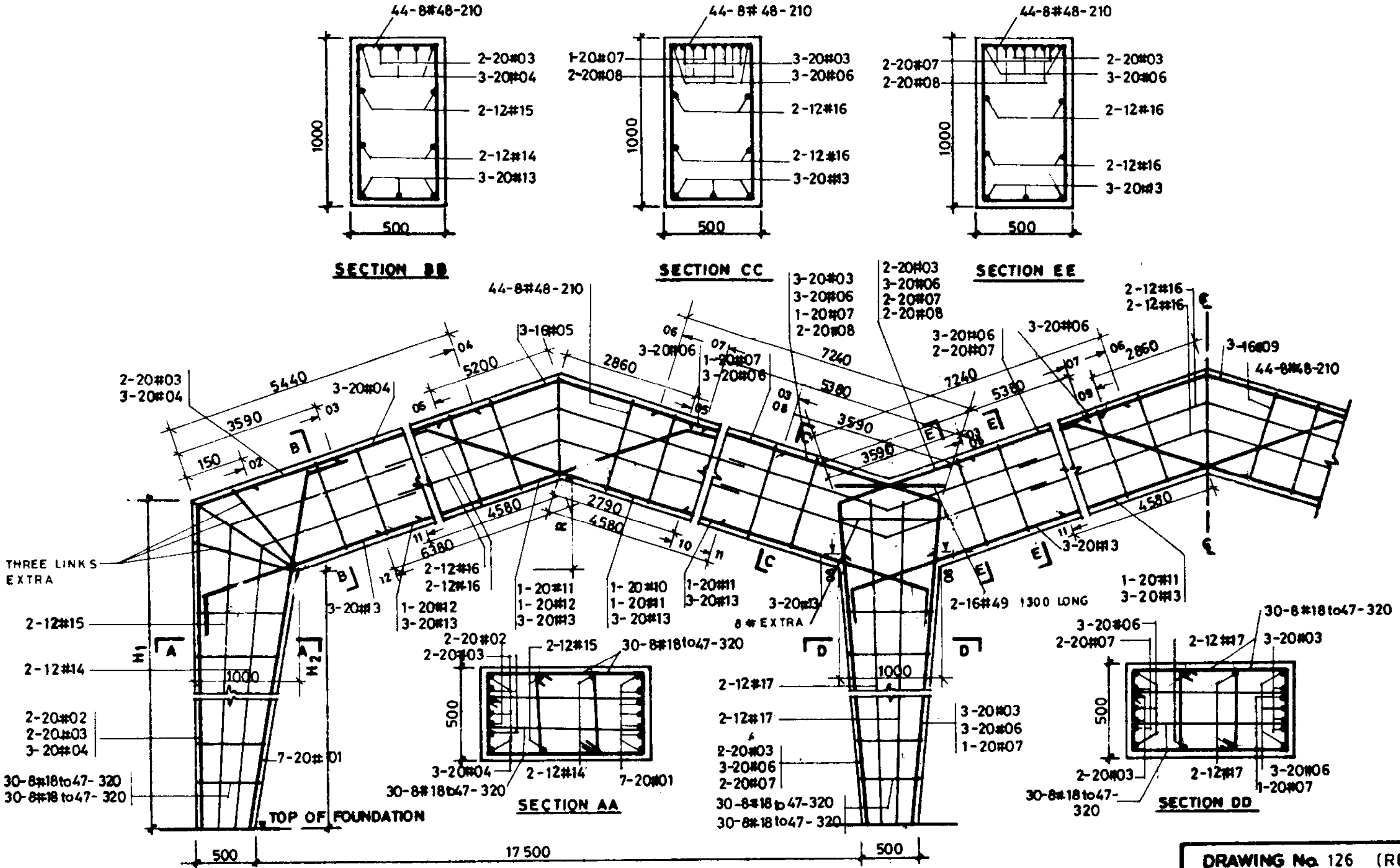
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	6817	6176	2850	8	1369	8	1270
1 in 4	6846	6149	2138	8	1338	8	1240
1 in 5	6864	6131	1710	8	1323	8	1225

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE 125
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300
   c. VALLEY : 300

DRAWING No. 125 (REFER TABLE 125)

No. OF BAYS : THREE
SPAN : 18.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 6.5 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS :
CONCRETE : M25
STEEL : Fe 415



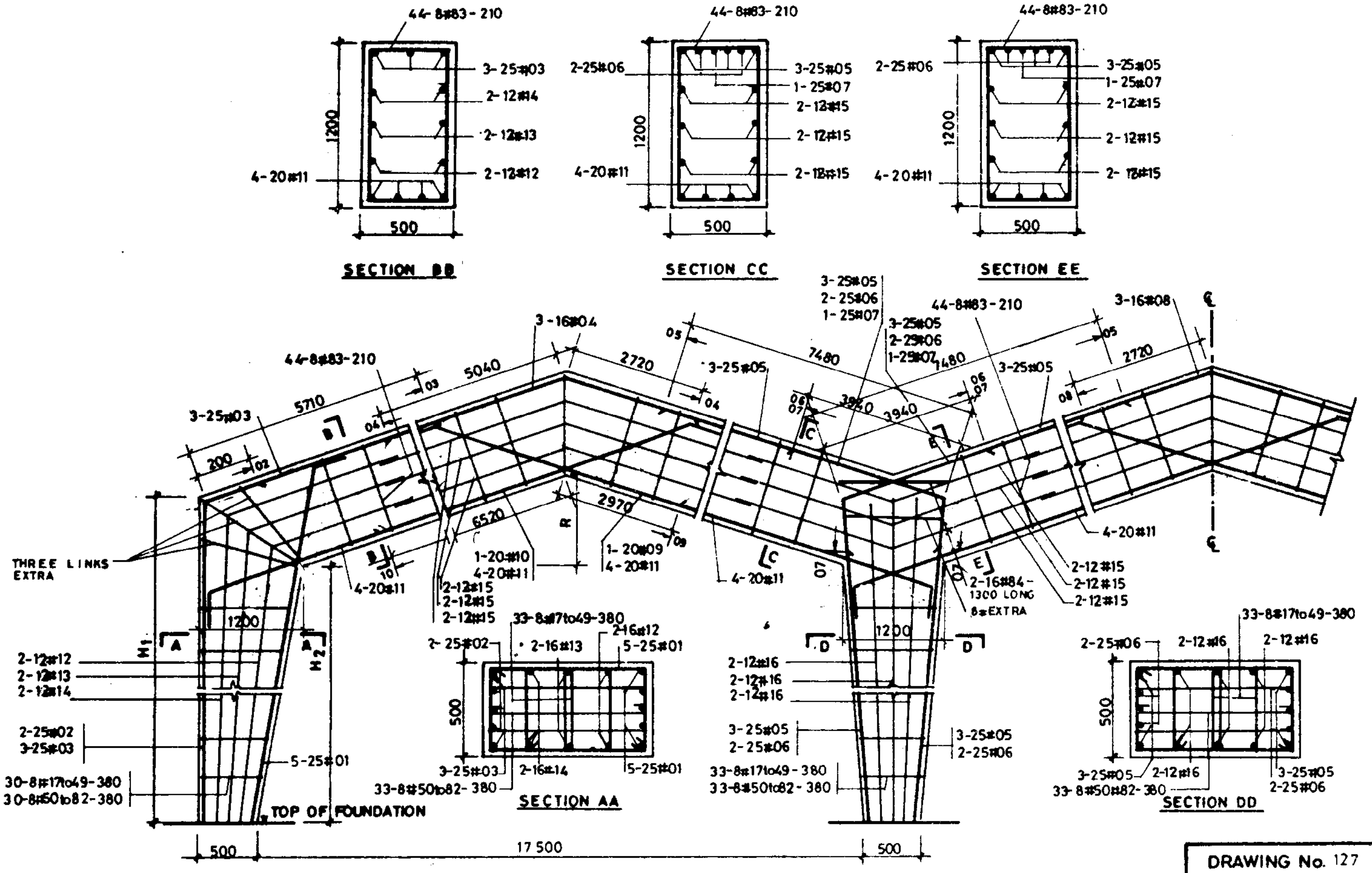
SLOPE	H1	H2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	9854	9140	2833	8	1376	8	1270
1 in 4	9885	9110	2125	8	1345	8	1240
1 in 5	9905	9090	1700	8	1330	8	1225

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE 126
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300
   c. VALLEY : 300

DRAWING No. 126 (REFER TABLE 126)

No. OF BAYS : THREE
SPAN : 18.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 9.5 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS :
CONCRETE : M25
STEEL : Fe 415



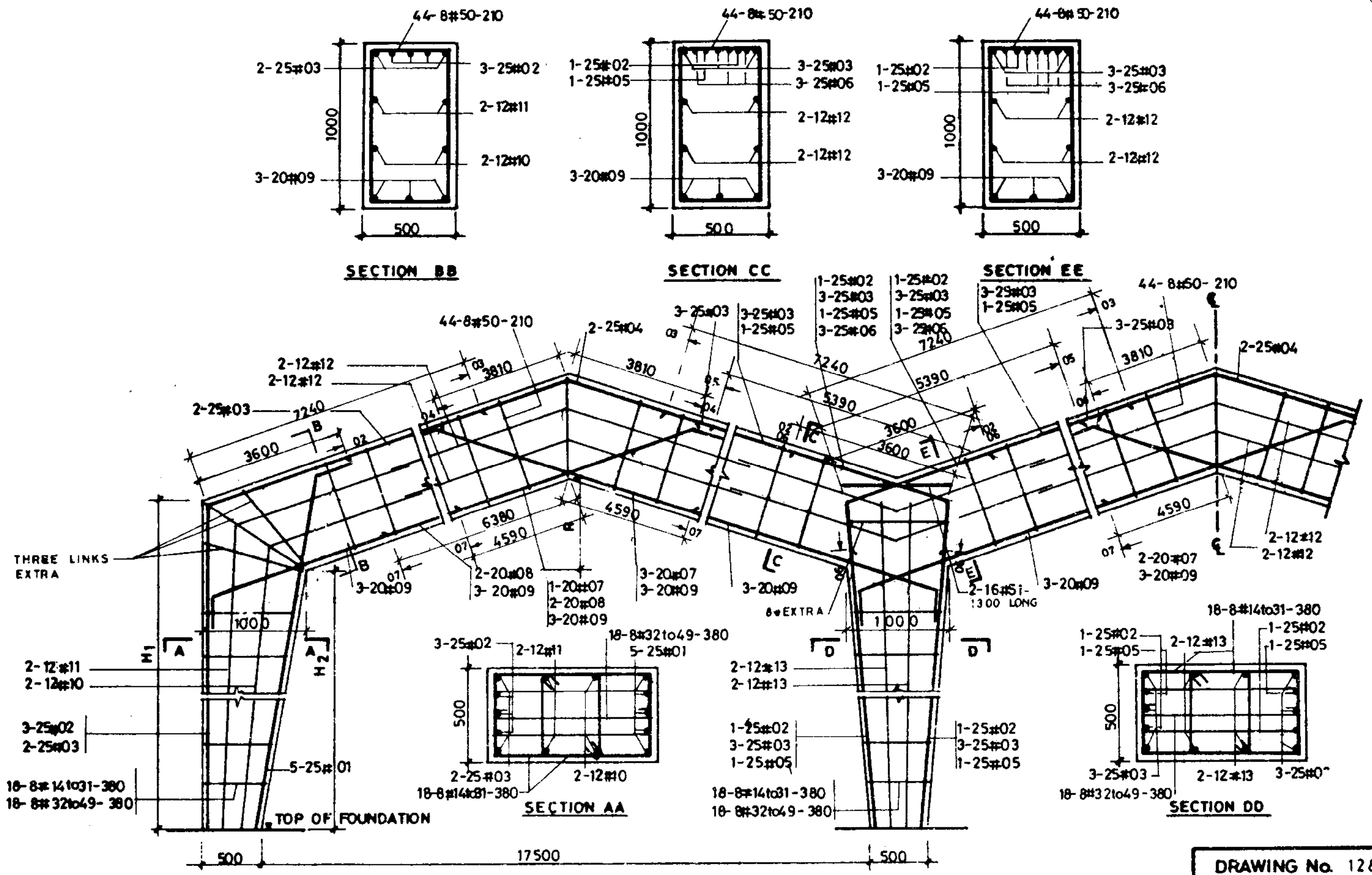
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	12924	12068	2800	8	1392	8	1270
1 in 4	12961	12032	2100	8	1361	8	1240
1 in 5	12986	12008	1680	8	1346	8	1225

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE 127
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300
   c. VALLEY : 300

DRAWING No. 127 (REFER TABLE 127)

No. OF BAYS	: THREE
SPAN	: 18.0 m
SPACING	: 6.0 m
COLUMN HEIGHT	: 12.5 m
SUPPORT CONDITION FOR ALL WIND AND SEISMIC ZONES	: HINGED
MATERIALS :	
CONCRETE	: M25
STEEL	: Fe 415



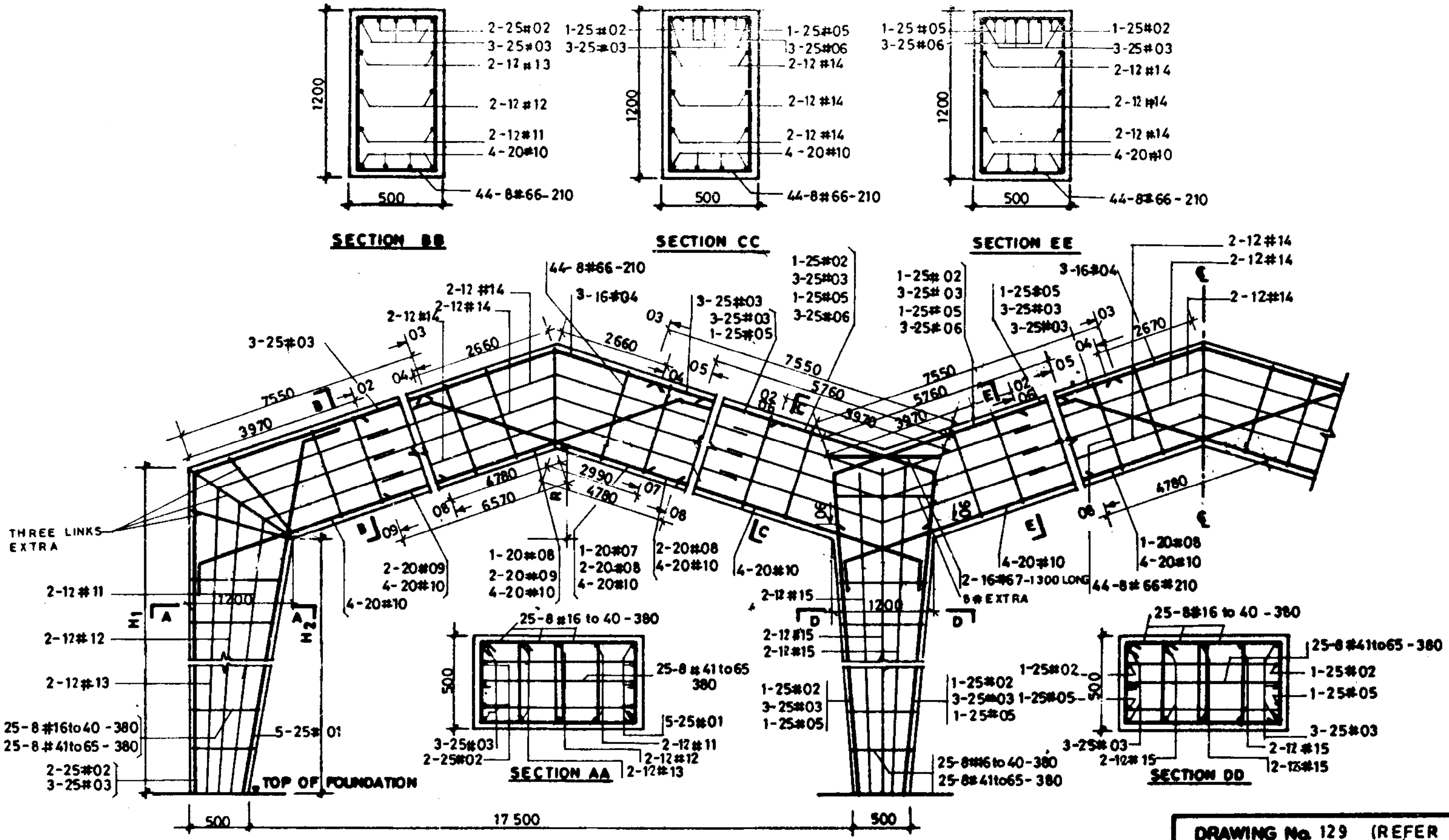
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	6851	6140	2833	8	1369	8	1225
1 in 4	6883	6110	2125	8	1338	7	1395
1 in 5	6903	6090	1700	8	1323	7	1378

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE - 128
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   - a) EXTERNAL COLUMN FACE : 100
   - b) RIDGE : 360
   - c) VALLEY : 550

DRAWING No. 128 (REFER TABLE 128)

No. OF BAYS	: THREE
SPAN	: 18.0 m
SPACING	: 12.0 m
COLUMN HEIGHT	: 6.5 m
SUPPORT CONDITION	: HINGED
FOR ALL WIND AND SEISMIC ZONES	
MATERIALS :	
CONCRETE	: M25
STEEL	: Fe 415



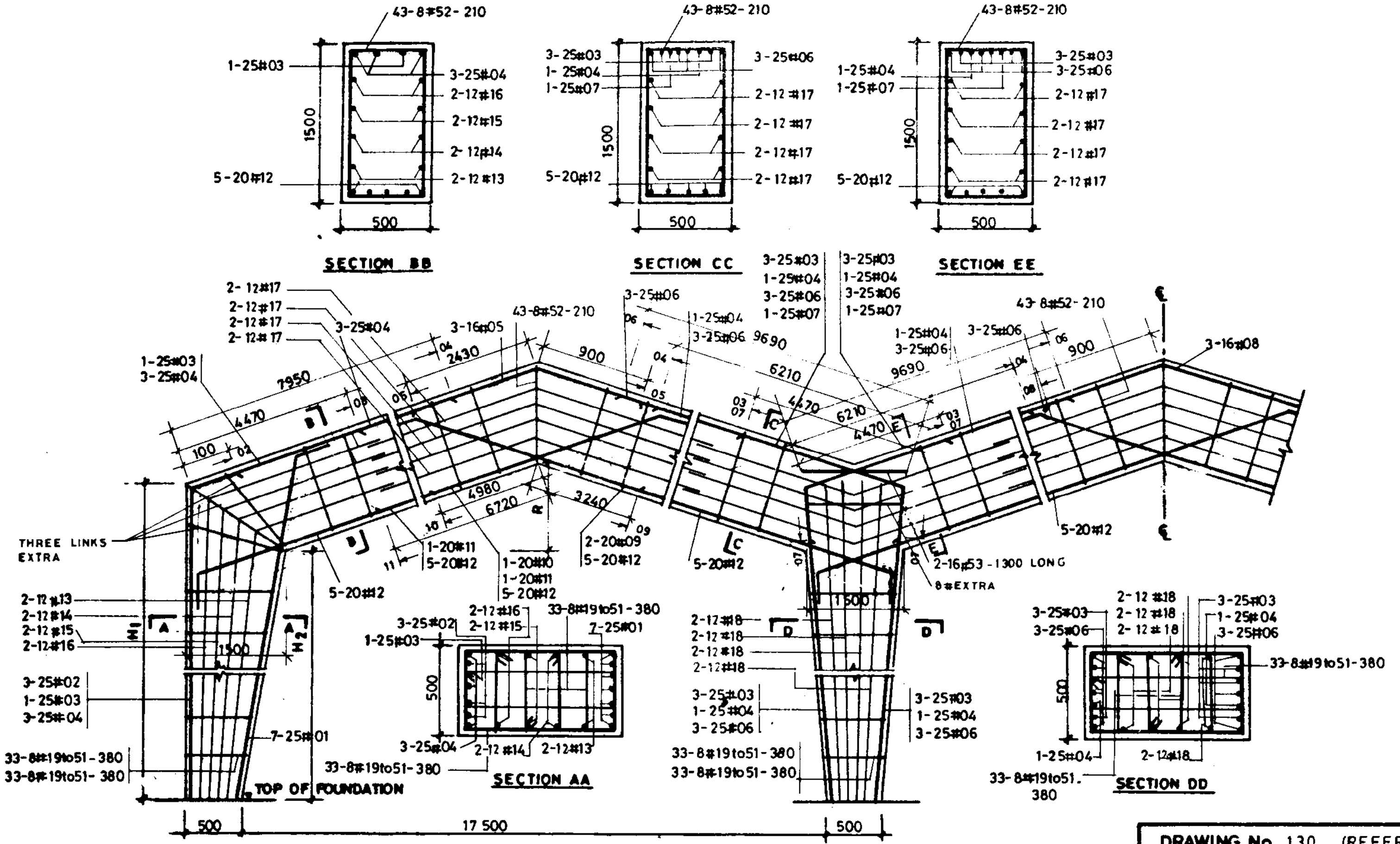
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	9922	9068	2800	8	1386	8	1225
1 in 4	9959	9032	2100	8	1353	7	1395
1 in 5	9984	9008	1680	8	1339	7	1378

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE_129
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360
   c. VALLEY : 550

DRAWING No. 129 (REFER TABLE 129)

No. OF BAYS : THREE
SPAN : 18.0 m
SPACING : 12.0 m
COLUMN HEIGHT : 9.5 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS :
CONCRETE : M25
STEEL : Fe 415



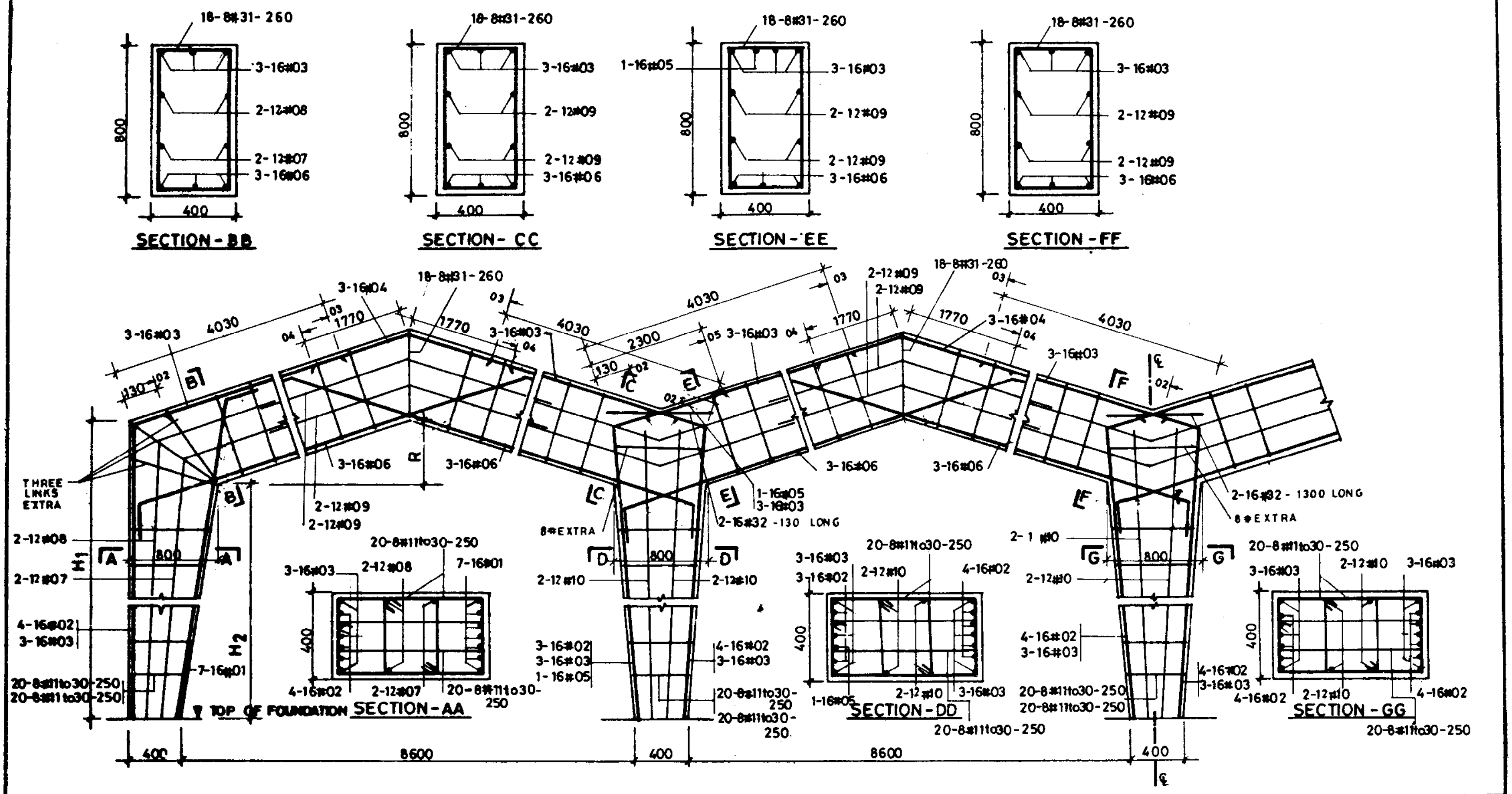
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS EXTERIOR RAFTER No. OF PURLINS	 SPACING	 INTERIOR RAFTER No. OF PURLINS	 SPACING
1 in 3	13026	11960	2750	8	1409	8	1225
1 in 4	13074	11915	2063	8	1377	7	1395
1 in 5	13105	11885	1650	8	1362	7	1378

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE _ 130
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360
   c. VALLEY : 550

DRAWING No. 130 (REFER TABLE 130)

No. OF BAYS	: THREE
SPAN	: 18.0 m
SPACING	: 12.0 m
COLUMN HEIGHT	: 12.5 m
SUPPORT CONDITION	: HINGED
FOR ALL WIND AND SEISMIC ZONES	
MATERIALS :	
CONCRETE	: **M25**
STEEL	: **Fe 415**



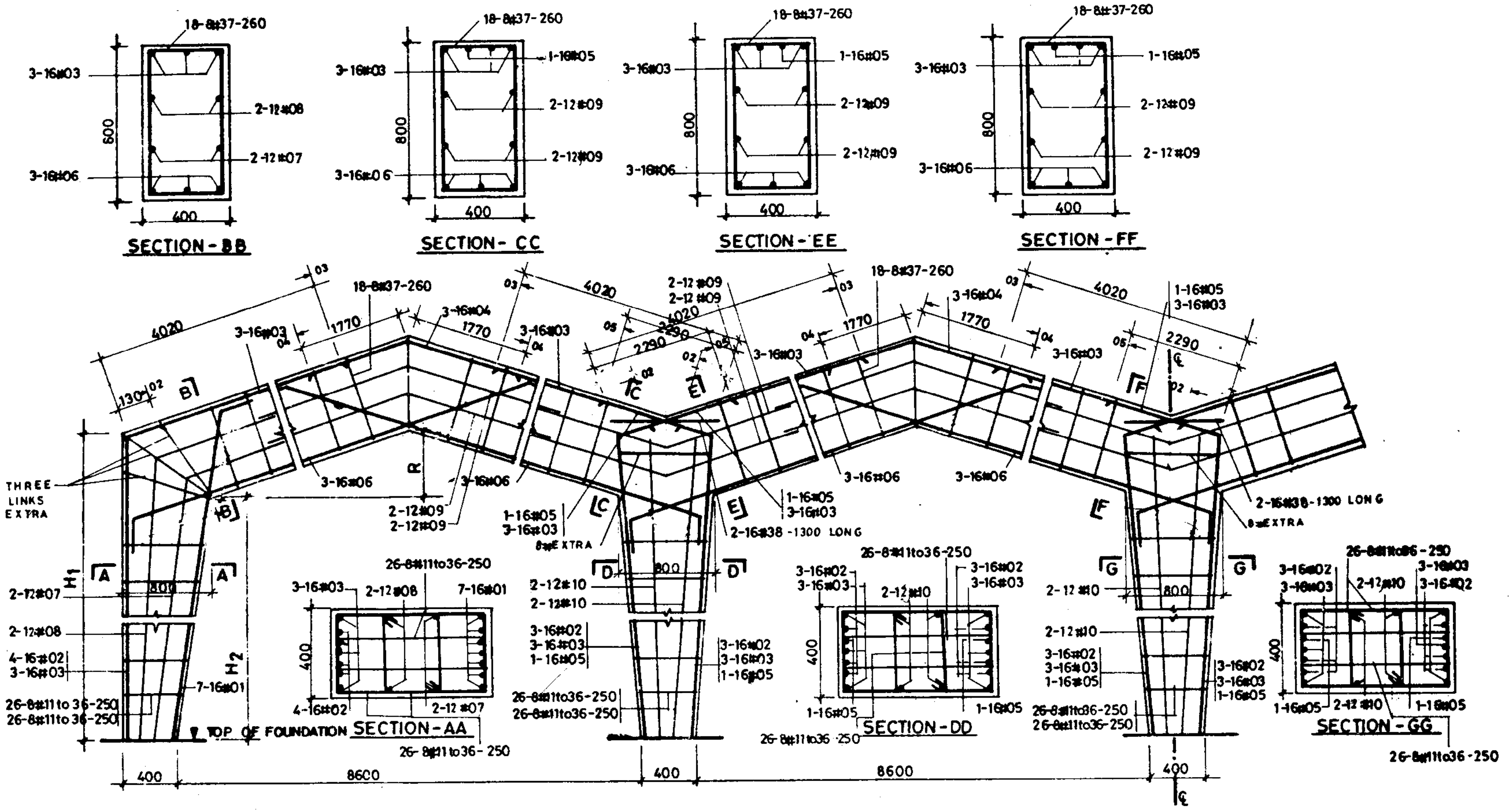
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	5280	4712	1367	5	1198	4	1381
1 in 4	5306	4688	1025	5	1170	4	1346
1 in 5	5322	4672	820	5	1156	4	1330

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE_131
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   - a. EXTERNAL COLUMN FACE : 100
   - b. RIDGE : 300
   - c. VALLEY : 300

DRAWING No. 131 (REFER TABLE 131)

No. OF BAYS	:	FOUR
SPAN	:	9.0 m
SPACING	:	6.0 m
COLUMN HEIGHT	:	5.0 m
SUPPORT CONDITION	:	HINGED
FOR ALL WIND AND SEISMIC ZONES		
MATERIALS :		
CONCRETE	:	M 25
STEEL	:	Fe 415



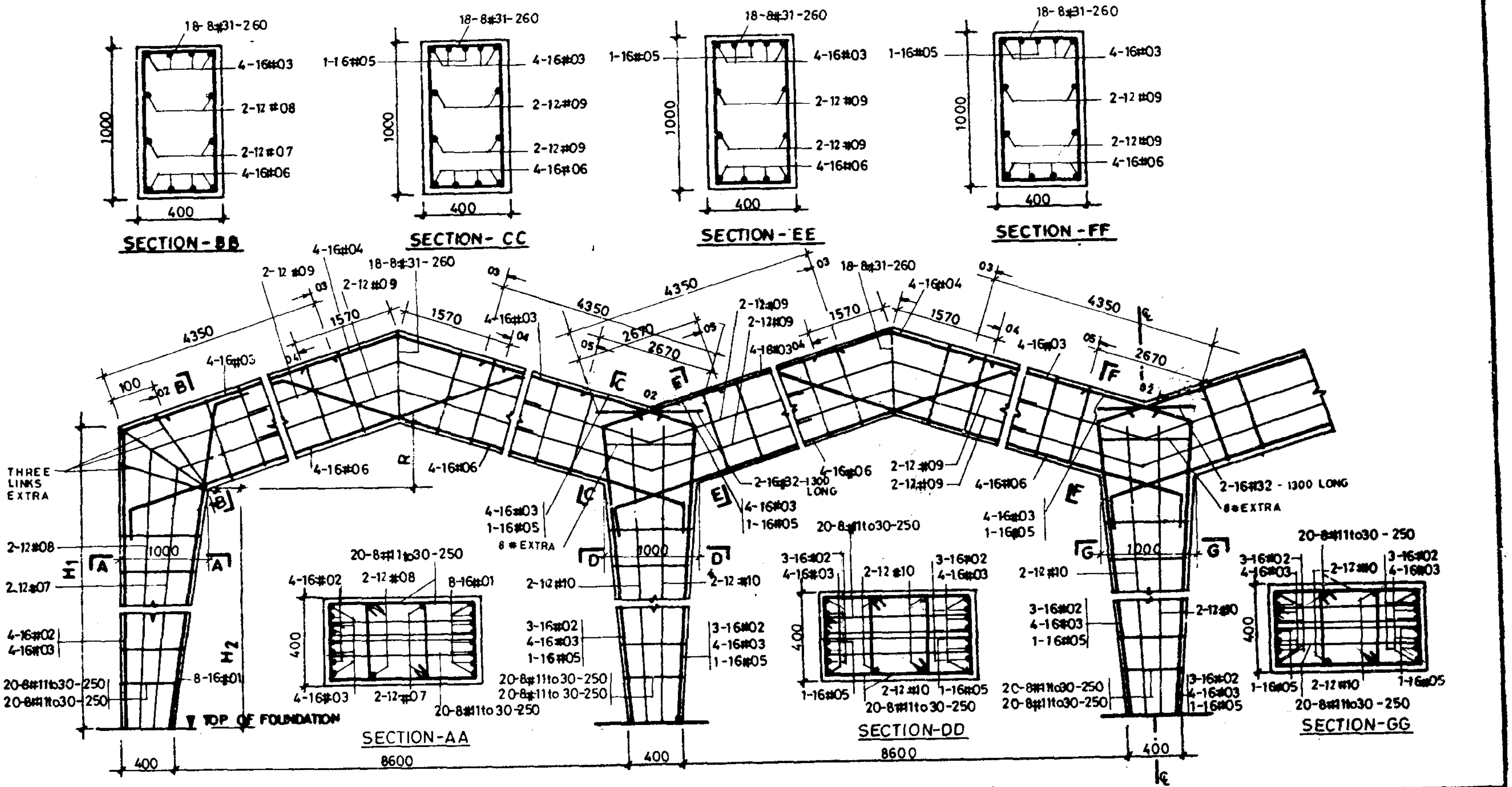
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	6782	6212	1367	5	1197	4	1381
1 in 4	6807	6188	1025	5	1168	4	1346
1 in 5	6824	6172	820	5	1155	4	1330

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE 132
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300
   c. VALLEY : 300

DRAWING No. 132 (REFER TABLE 132)

NO. OF BAYS : FOUR
SPAN : 9.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 6.5 m
SUPPORT CONDITION FOR ALL WIND AND SEISMIC ZONES : HINGED
MATERIALS :
CONCRETE : M 25
STEEL : Fe 415



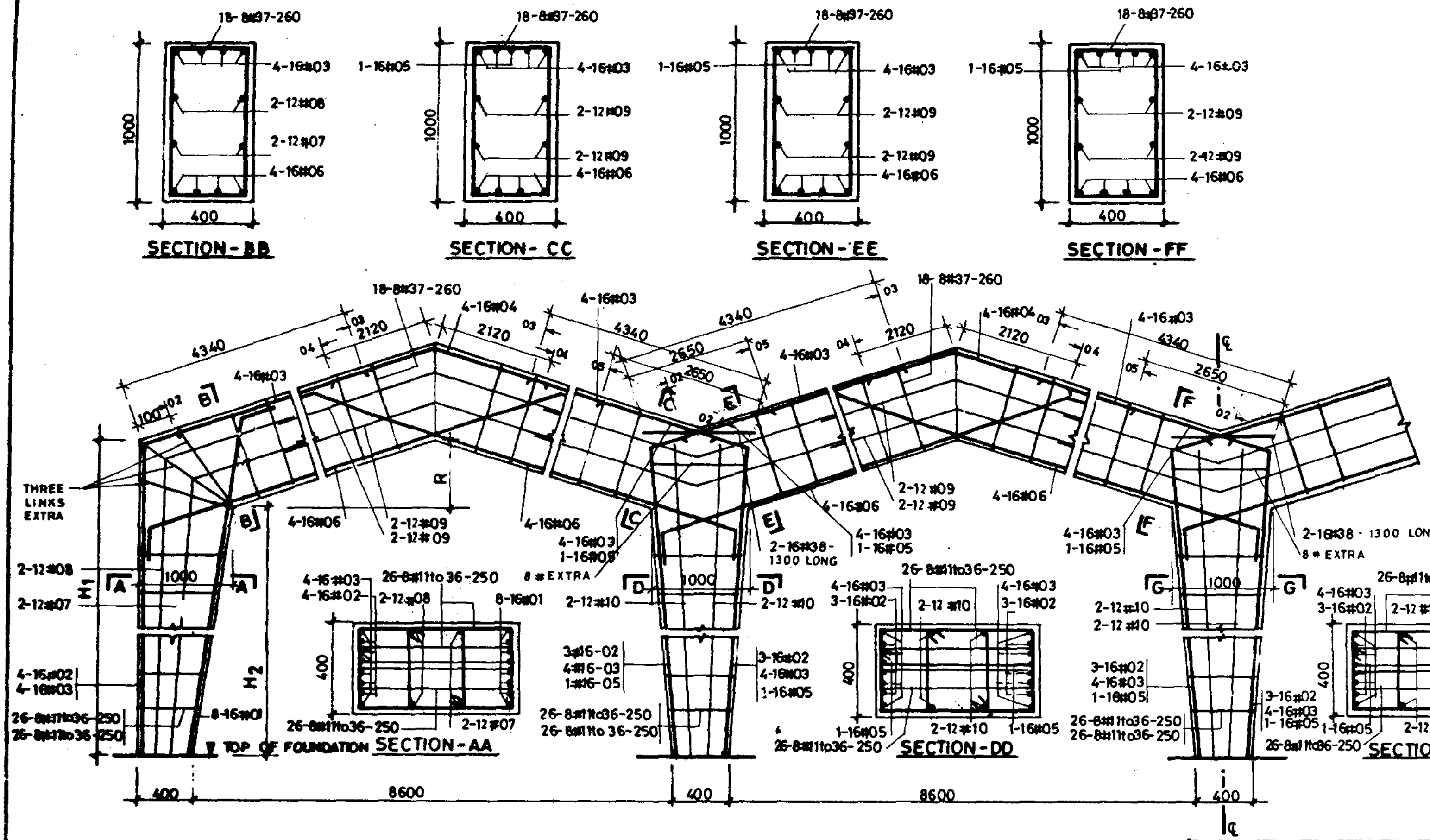
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	5345	4640	1333	5	1215	4	1361
1 in 4	5370	4610	1000	5	1186	4	1326
1 in 5	5399	4590	800	5	1173	4	1310

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE - 133
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360
   c. VALLEY : 300

DRAWING No. 133 (REFER TABLE 133)

No. OF BAYS	: FOUR
SPAN	: 9.0 m
SPACING	: 12.0 m
COLUMN HEIGHT	: 5.0 m
SUPPORT CONDITION	: HINGED
FOR ALL WIND AND SEISMIC ZONES	
MATERIALS :	
CONCRETE	: M 25
STEEL	: Fe 415



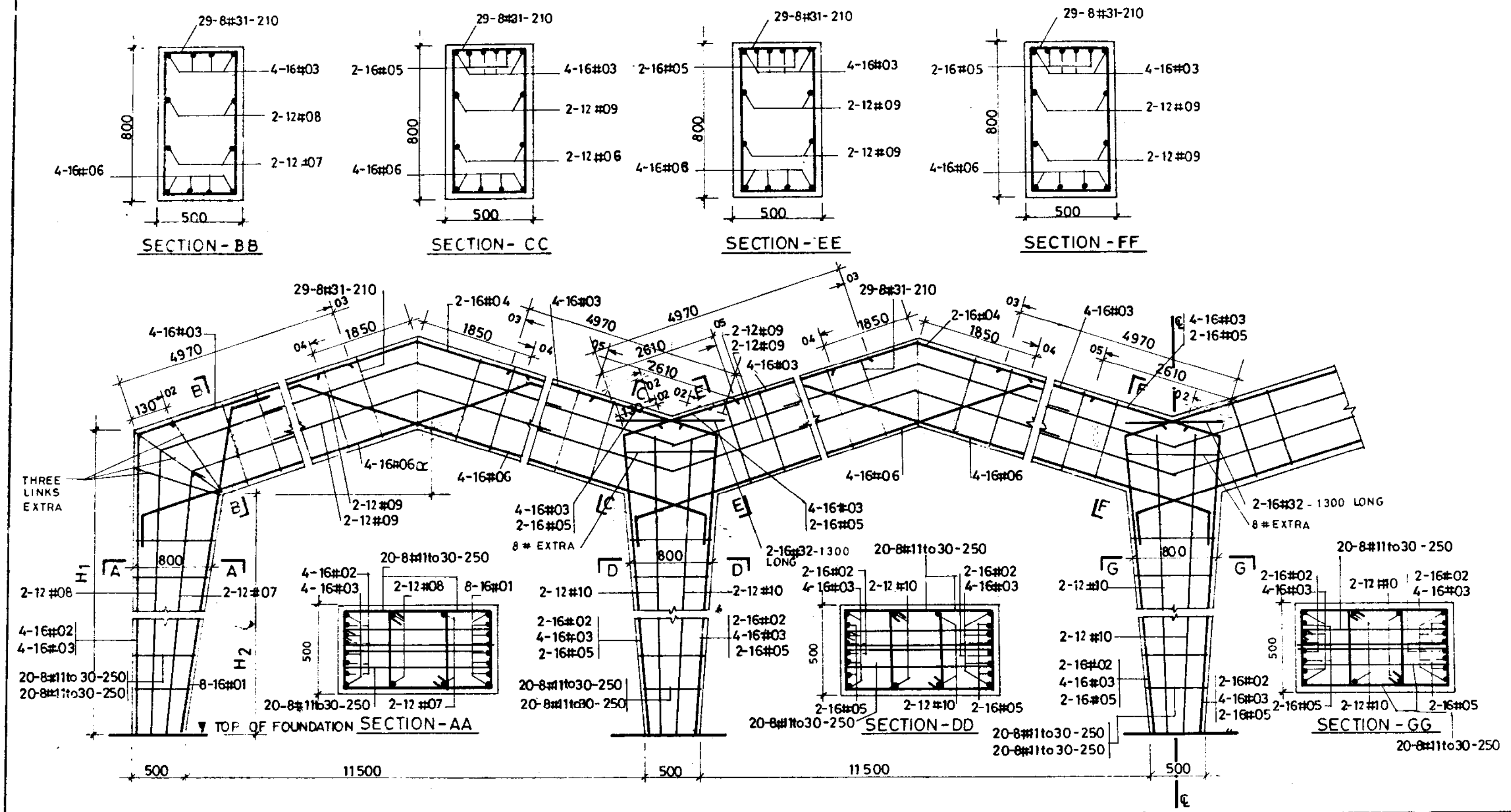
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	6849	6140	1333	5	1212	4	1361
1 in 4	6881	6110	1000	5	1183	4	1326
1 in 5	6902	6090	800	5	1170	4	1310

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE – 134
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   - a. EXTERNAL COLUMN FACE : 100
   - b. RIDGE : 360
   - c. VALLEY : 300

DRAWING No. 134 (REFER TABLE 134)

No. OF BAYS	: FOUR
SPAN	: 9.0 m
SPACING	: 12.0 m
COLUMN HEIGHT	: 6.5 m
SUPPORT CONDITION FOR ALL WIND AND SEISMIC ZONES	: HINGED
MATERIALS :	
CONCRETE	: M 25
STEEL	: Fe 415



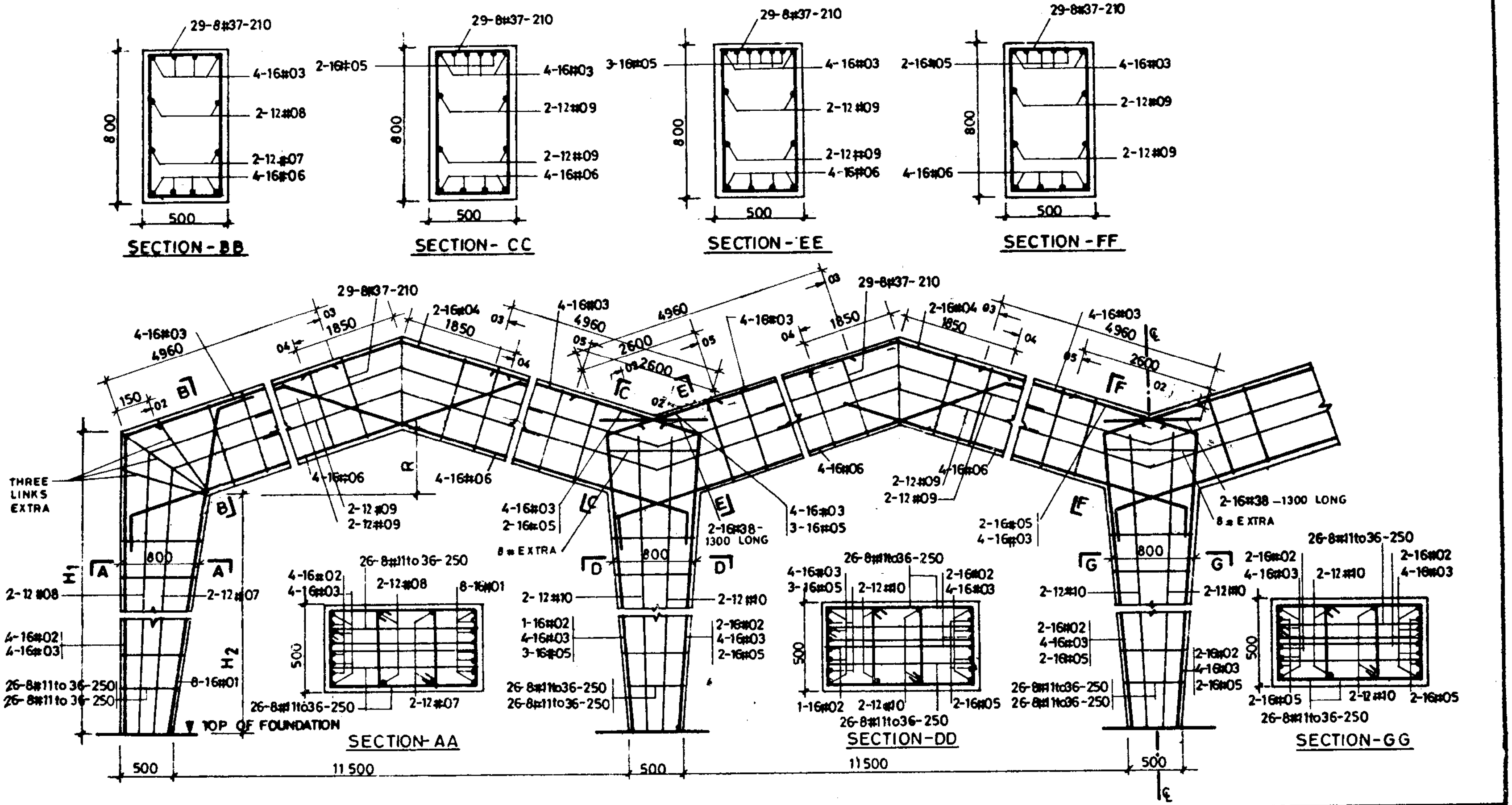
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	5282	4712	1867	6	1273	6	1145
1 in 4	5307	4688	1400	6	1243	5	1396
1 in 5	5324	4672	1120	6	1230	5	1380

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE 135
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300
   c. VALLEY : 300

DRAWING No. 135 (REFER TABLE 135)

No. OF BAYS : FOUR
SPAN : 12.0 m
SPACING : 6.0 m
COLUMN HEIGHT : 5.0 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS :
CONCRETE : M 25
STEEL : Fe 415



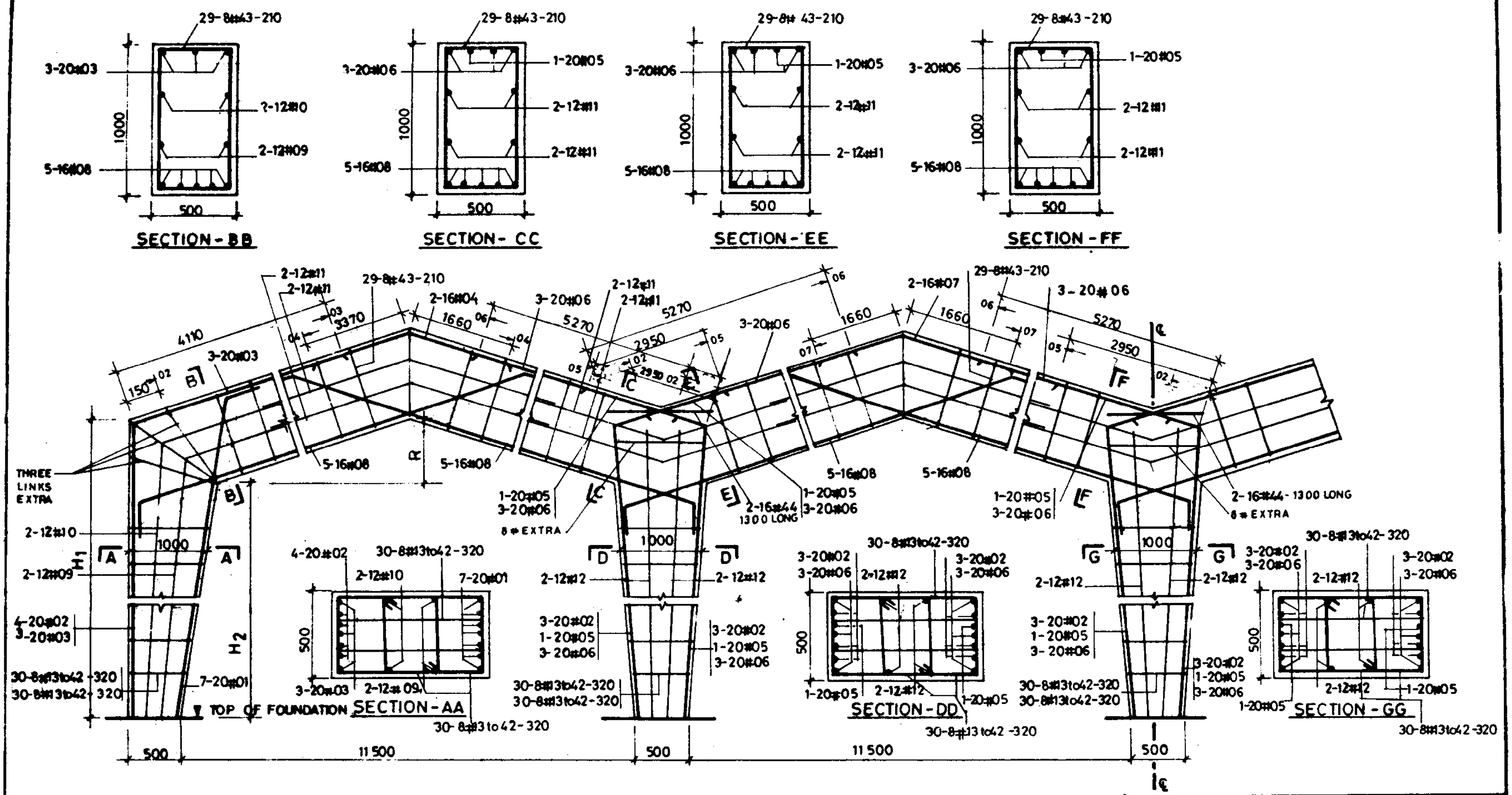
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	6784	6212	1867	6	1272	6	1145
1 in 4	6809	6188	1400	6	1243	5	1396
1 in 5	6825	6172	1120	6	1229	5	1380

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE_136
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 300
   c. VALLEY : 300

DRAWING No. 136 (REFER TABLE 136)

No. OF BAYS	: FOUR
SPAN	: 12.0 m
SPACING	: 6.0 m
COLUMN HEIGHT	: 6.5 m
SUPPORT CONDITION	: HINGED
FOR ALL WIND AND SEISMIC ZONES	
MATERIALS :	
CONCRETE	: M 25
STEEL	: Fe 415



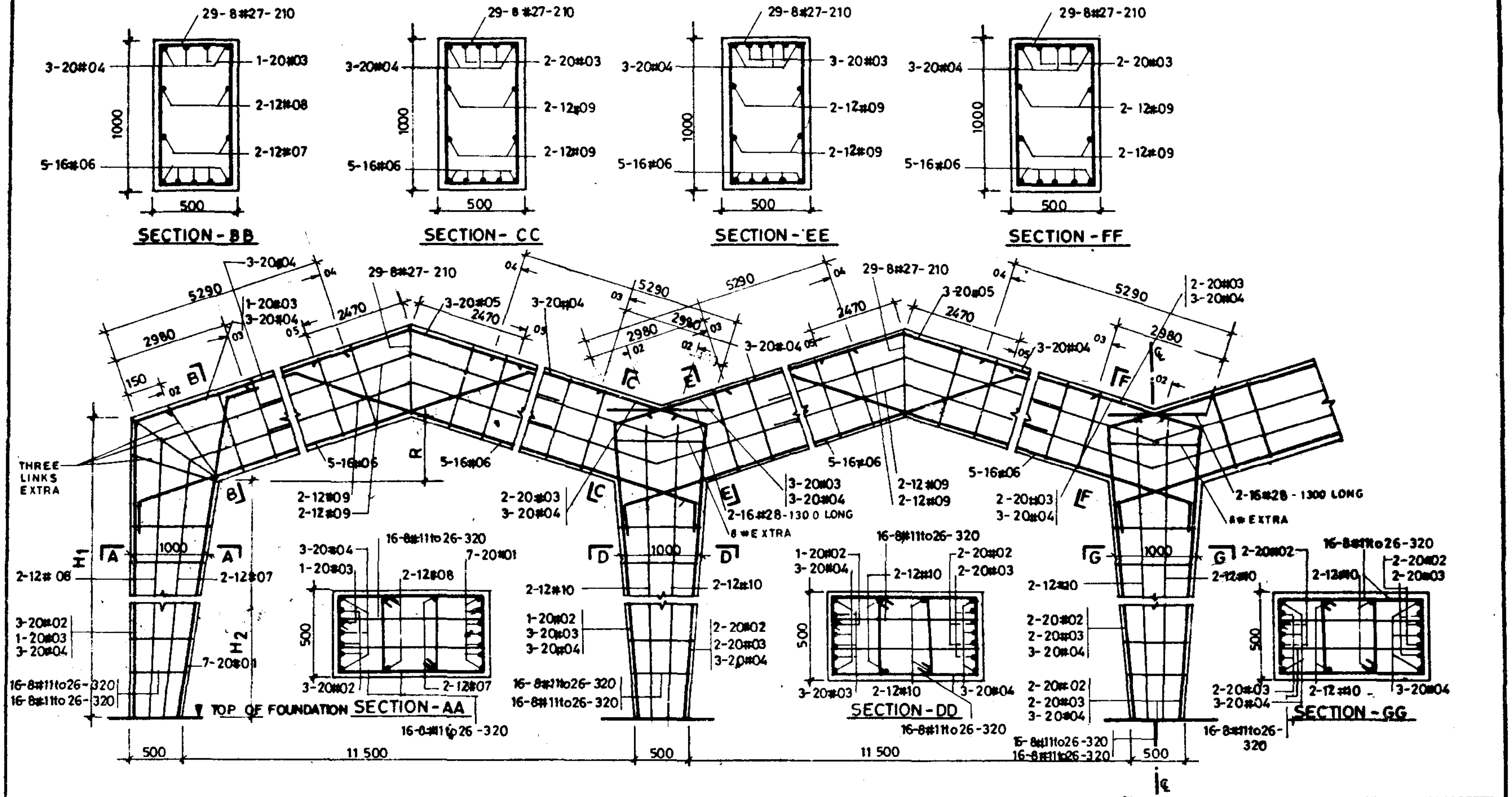
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	9854	9140	1833	6	1295	6	1145
1 in 4	9885	9110	1375	6	1264	5	1396
1 in 5	9906	9090	1100	6	1250	5	1380

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE_137
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   - a. EXTERNAL COLUMN FACE : 100
   - b. RIDGE : 300
   - c. VALLEY : 300

DRAWING No. 137 (REFER TABLE 137)

No. OF BAYS	:	FOUR
SPAN	:	12.0 m
SPACING	:	6.0 m
COLUMN HEIGHT	:	9.5 m
SUPPORT CONDITION	:	HINGED
FOR ALL WIND AND SEISMIC ZONES		
MATERIALS :		
CONCRETE	:	M 25
STEEL	:	Fe 415



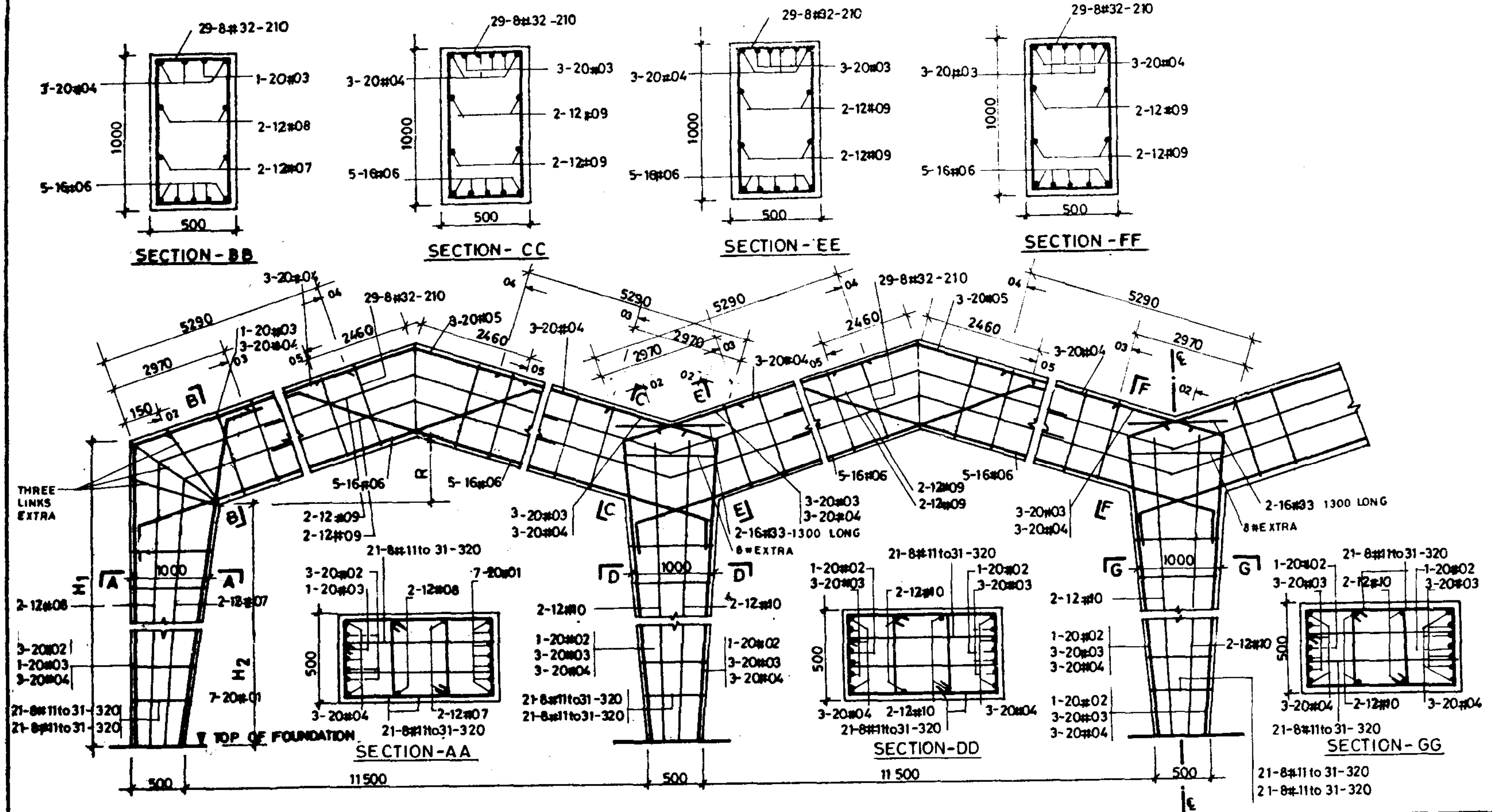
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	5348	4640	1833	6	1287	5	1416
1 in 4	5380	4680	1375	6	1257	5	1381
1 in 5	5402	4590	1100	6	1243	5	1365

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE 138
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   - a. EXTERNAL COLUMN FACE : 100
   - b. RIDGE : 360
   - c. VALLEY : 300

DRAWING No. 138 (REFER TABLE 138)

No. OF BAYS : FOUR
SPAN : 12.0 m
SPACING : 12.0 m
COLUMN HEIGHT : 5.0 m
SUPPORT CONDITION FOR ALL WIND AND SEISMIC ZONES : HINGED
MATERIALS :
CONCRETE : M 25
STEEL : Fe 415



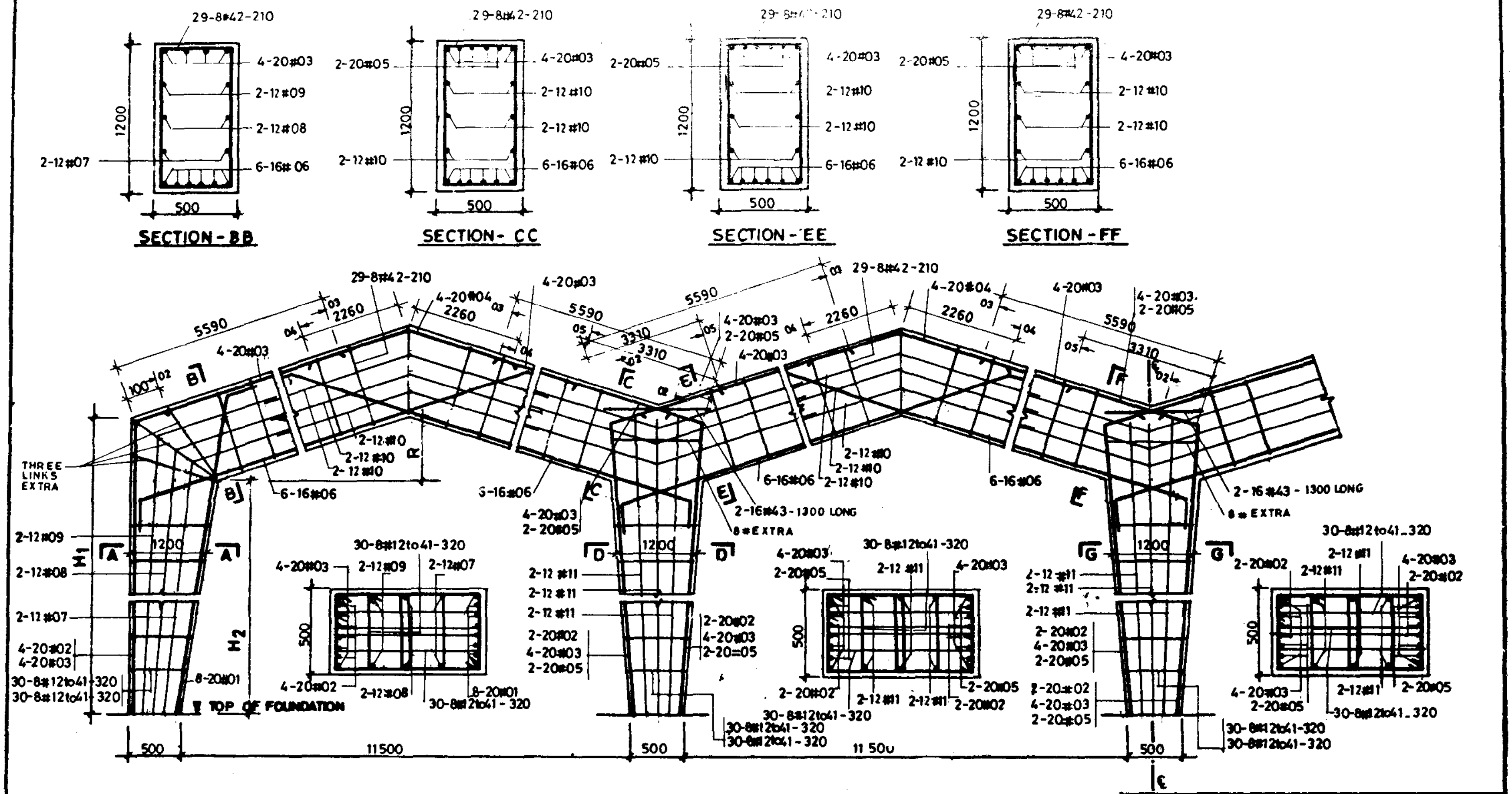
DRAWING No. 139 (REFER TABLE 139)

No. OF BAYS : FOUR
SPAN : 12.0 m
SPACING : 12.0 m
COLUMN HEIGHT : 6.5 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS :
CONCRETE : M 25
STEEL : Fe 415

SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	6851	6140	1833	6	1285	5	1416
1 in 4	6883	6110	1375	6	1254	5	1381
1 in 5	6903	6090	1100	6	1241	5	1365

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE _139
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   a. EXTERNAL COLUMN FACE : 100
   b. RIDGE : 360
   c. VALLEY : 300



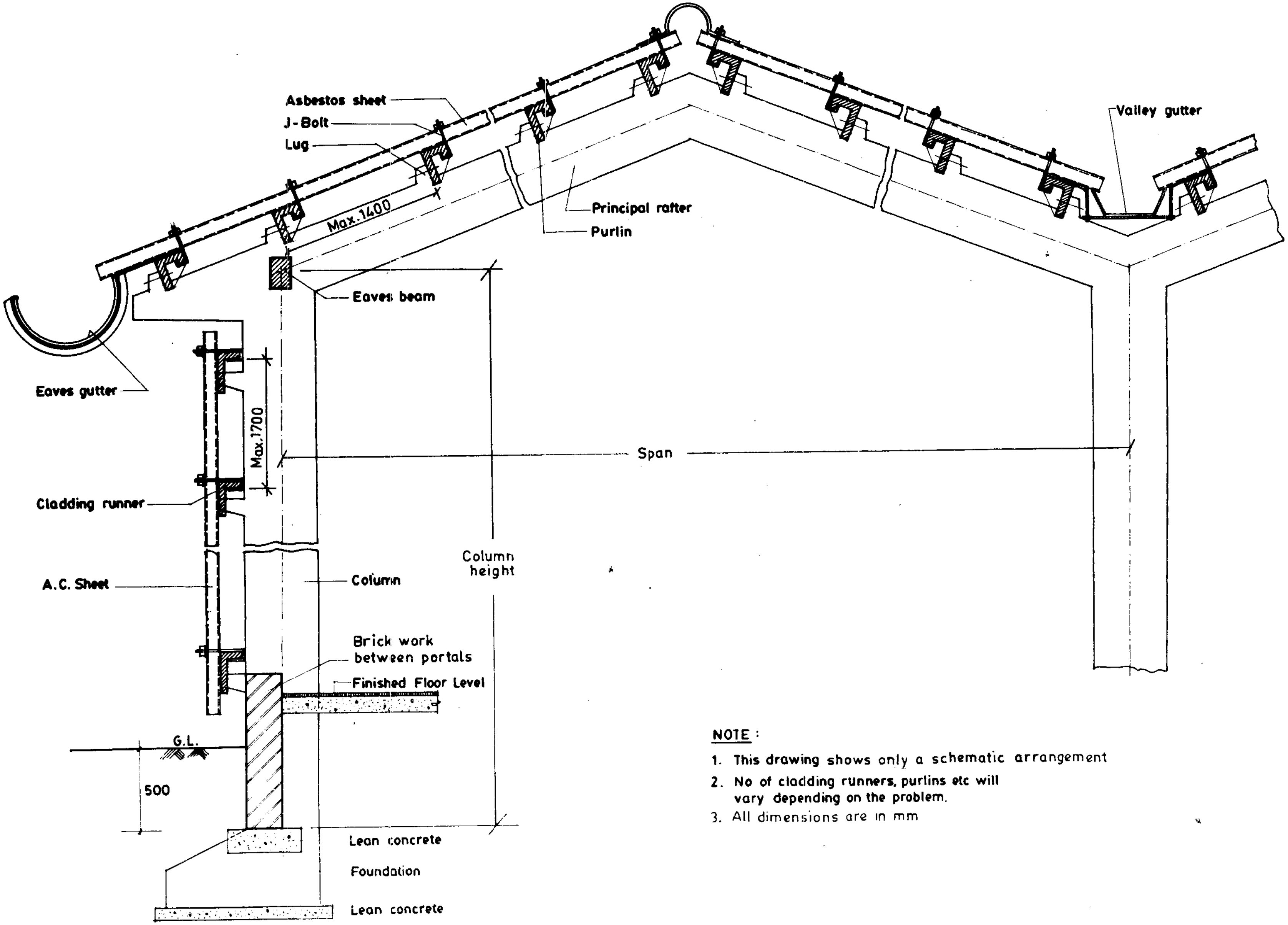
SLOPE	H_1	H_2	R	No. AND SPACING OF PURLINS			
				EXTERIOR RAFTER		INTERIOR RAFTER	
				No. OF PURLINS	SPACING	No. OF PURLINS	SPACING
1 in 3	9922	9068	1800	6	1306	5	1416
1 in 4	9959	9032	1350	6	1276	5	1381
1 in 5	9984	9008	1080	6	1262	5	1365

NOTE

1. ALL DIMENSIONS ARE IN mm
2. FOR FOUNDATION FORCES REFER TO ANALYSIS TABLE 140
3. DISTANCE OF THE NEAREST PURLIN LUG (℄) FROM THE
   - a. EXTERNAL COLUMN FACE : 100
   - b. RIDGE : 360
   - c. VALLEY : 300

DRAWING No. 140 (REFER TABLE 140)

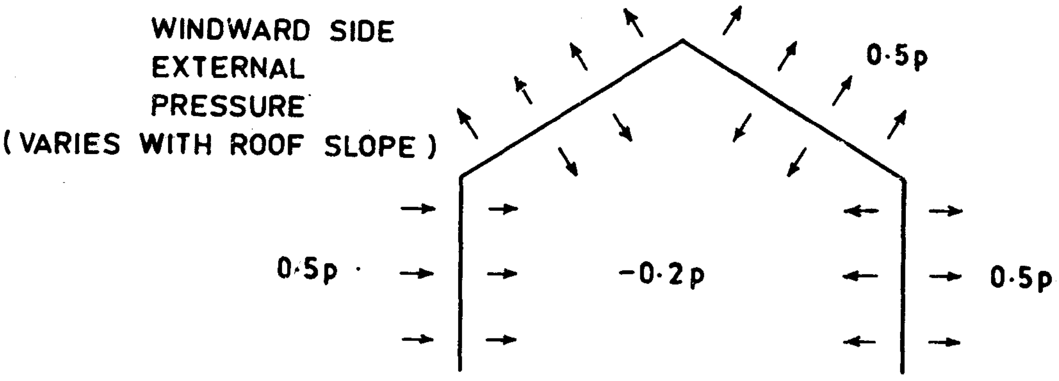
NO. OF BAYS : FOUR
SPAN : 12.0 m
SPACING : 12.0 m
COLUMN HEIGHT : 9.5 m
SUPPORT CONDITION : HINGED
FOR ALL WIND AND SEISMIC ZONES
MATERIALS :
CONCRETE : M 25
STEEL : Fe 415



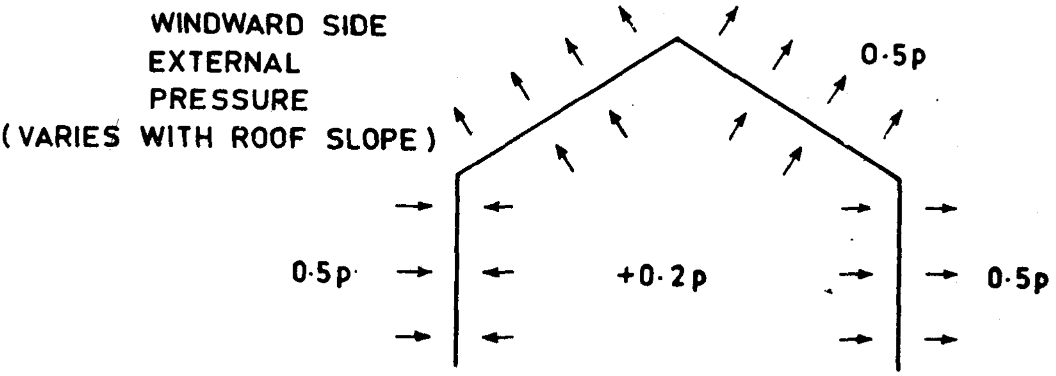
NOTE :

1. This drawing shows only a schematic arrangement
2. No of cladding runners, purlins etc will vary depending on the problem.
3. All dimensions are in mm

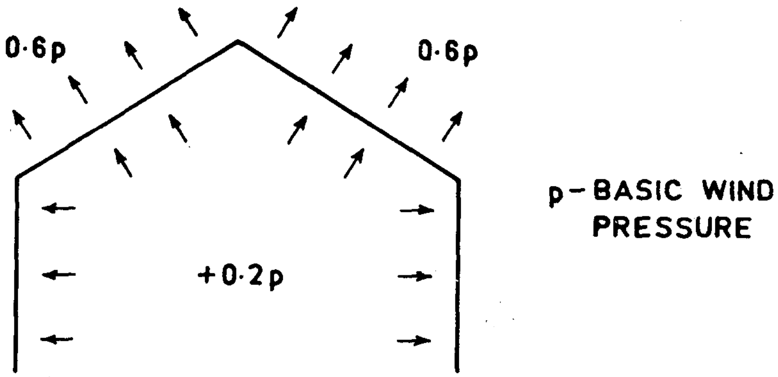
DRG No. 141 GENERAL ARRANGEMENT OF R.C PORTAL FRAMES



WL$_1$-WIND PERPENDICULAR TO RIDGE WITH INTERNAL SUCTION

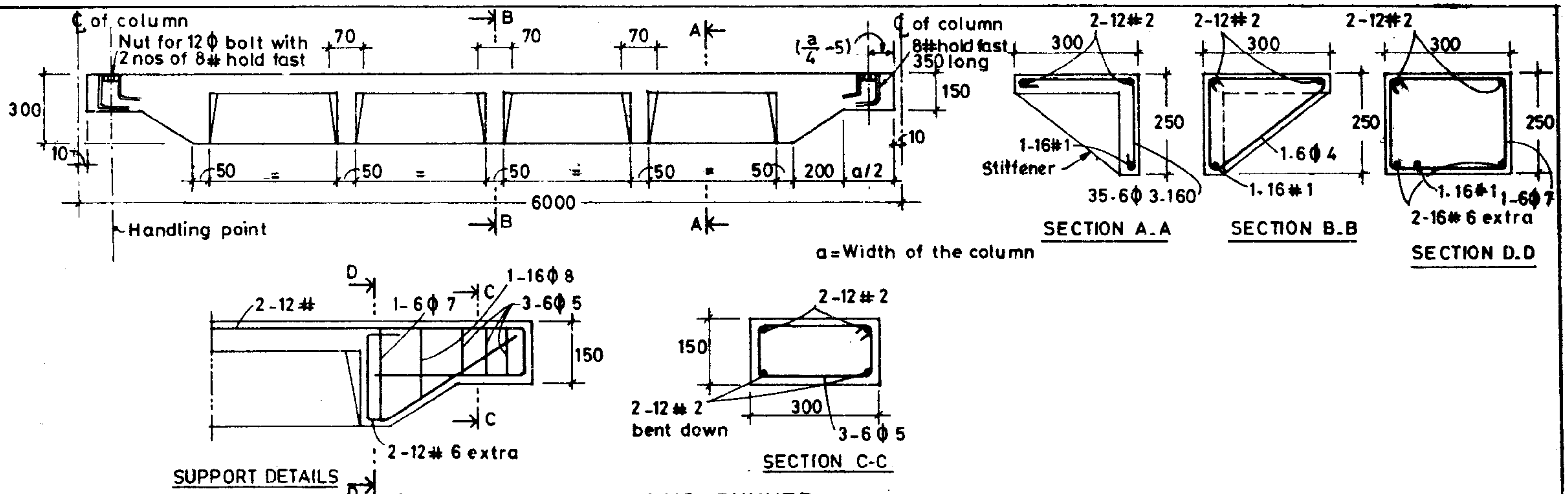


WL$_2$-WIND PERPENDICULAR TO RIDGE WITH INTERNAL PRESSURE

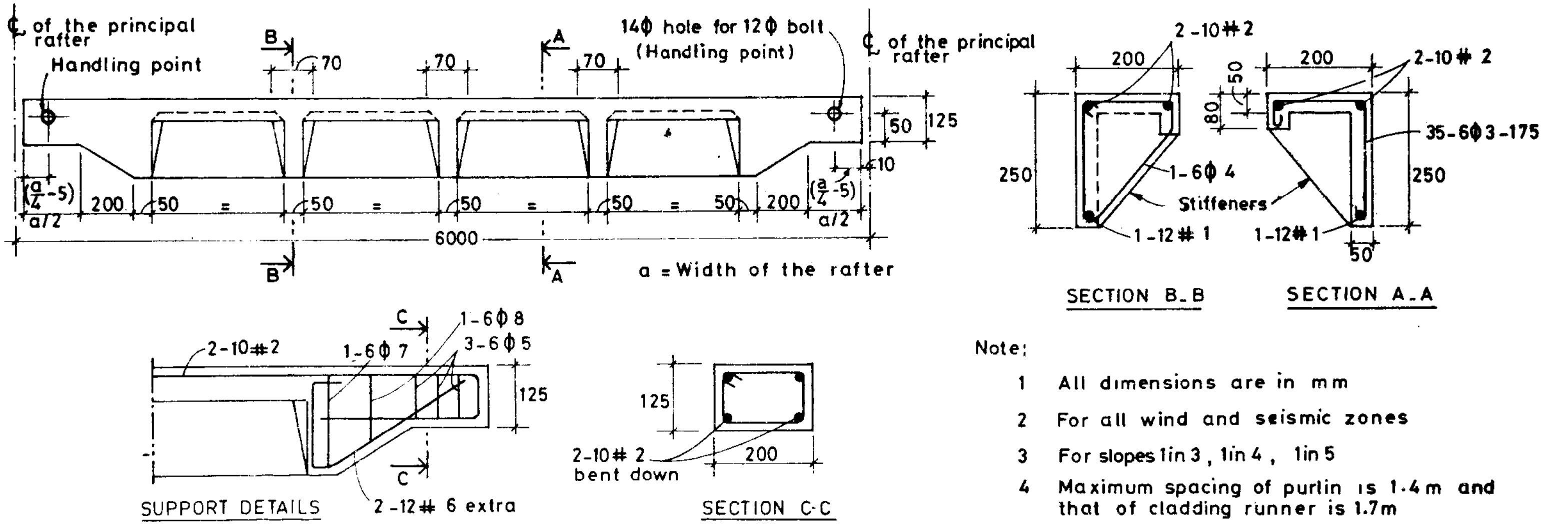


WL$_3$-WIND PARALLEL TO RIDGE WITH INTERNAL PRESSURE

DRG. 142 WIND LOAD ON PORTAL FRAMES



(a) 6m SPAN CLADDING RUNNER



(b) 6m SPAN PURLIN

DRG. No. 143 DETAILS OF 6m SPAN PURLIN AND CLADDING RUNNER

Note:

1 All dimensions are in mm

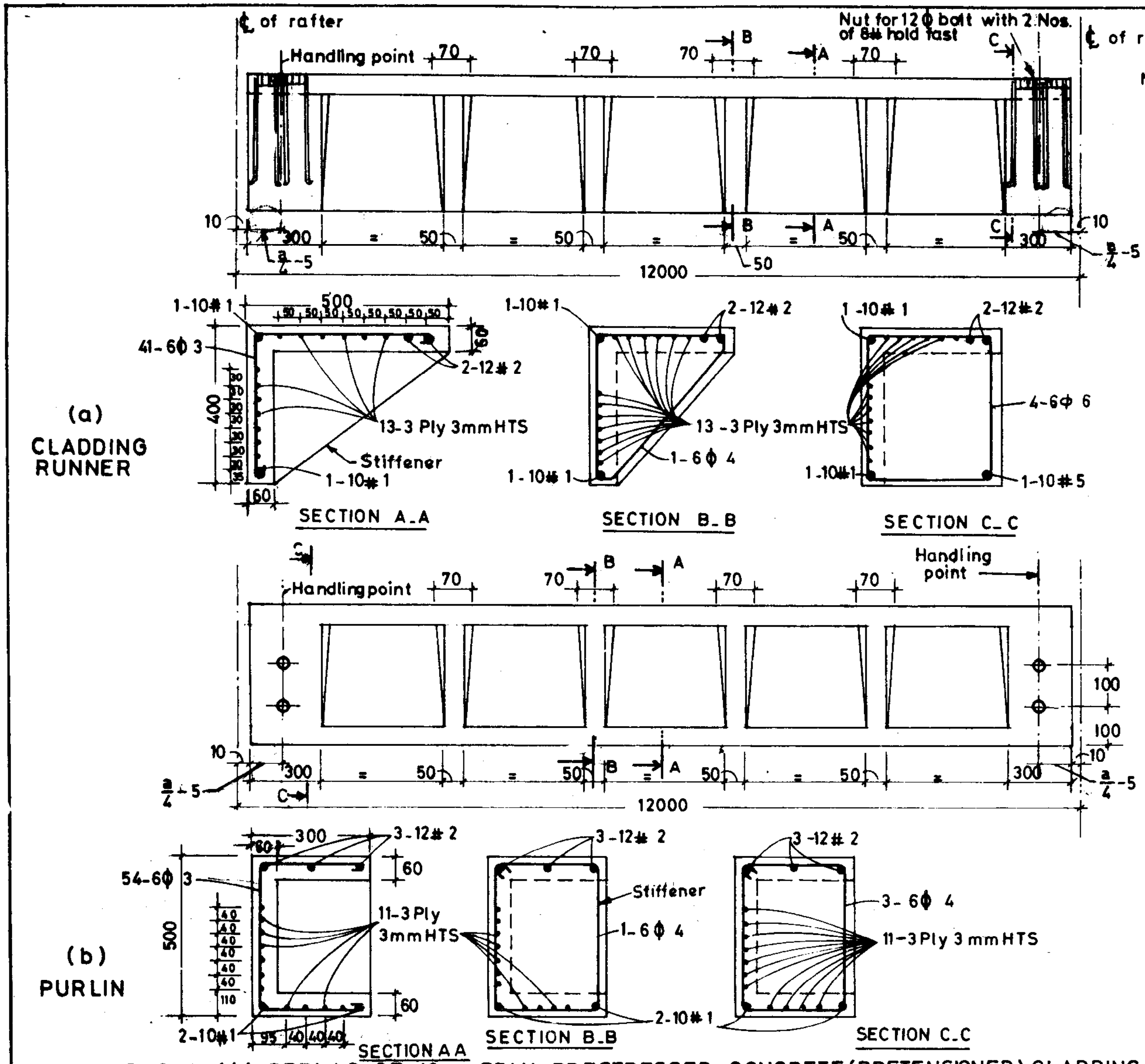
2 For all wind and seismic zones

3 For slopes 1 in 3, 1 in 4, 1 in 5

4 Maximum spacing of purlin is 1·4 m and that of cladding runner is 1.7 m

5 M25 Concrete & Fe 415 and Fe 250 steel

6 Handling should be in vertical position as it is to be finally placed



Note:

1 All dimensions are in mm

2 For all wind and seismic zones

3 For slopes 1in 3, 1in4 and 1in5

4 Maximum spacing of purlin is 1·4 m and that of cladding runner is 1·7m

5 Concrete M 40

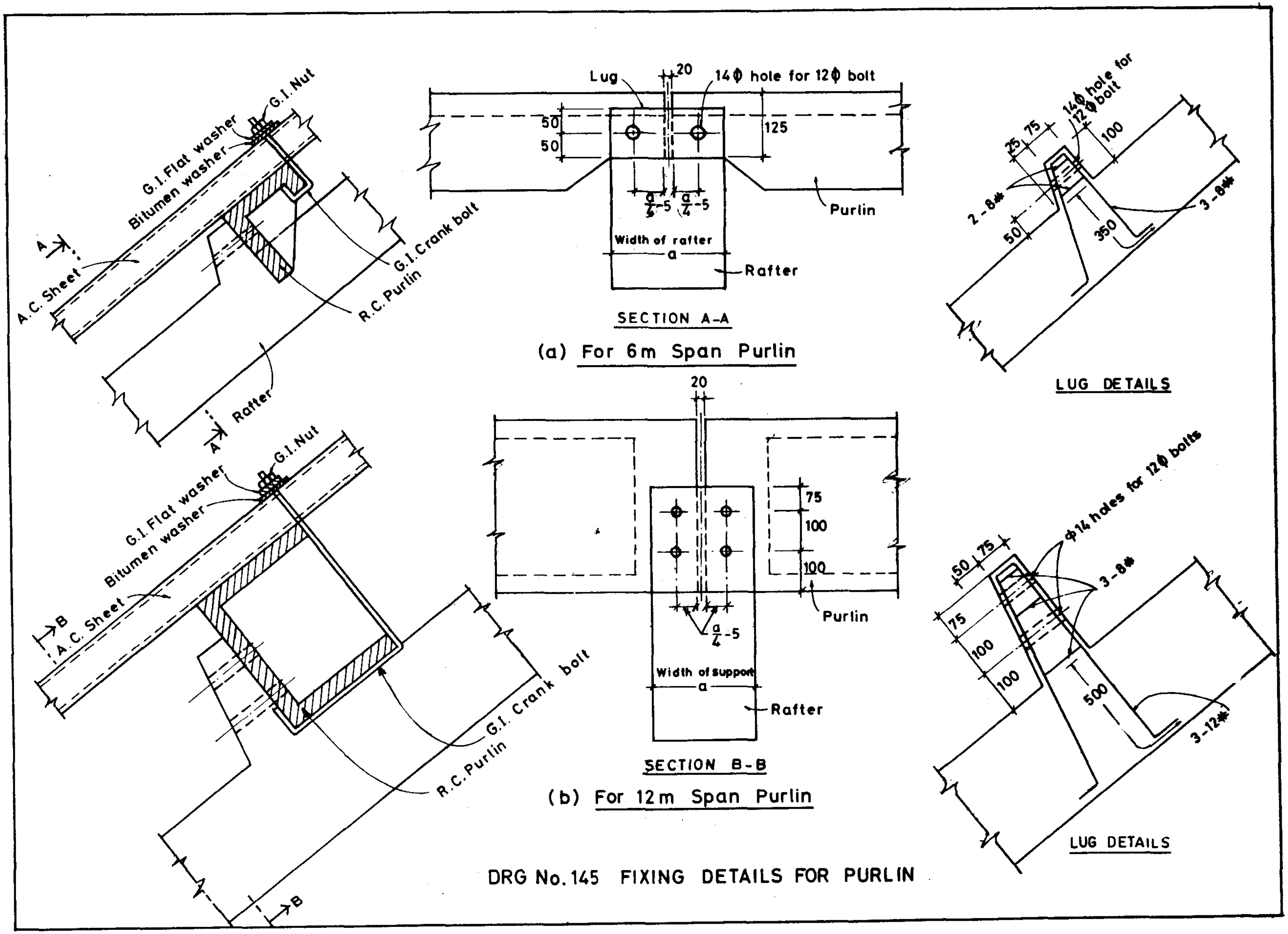
Steel I. Fe 415 and Fe 250

II. HTS (stress relieved strands) IS:6006-1983 initial prestressing force in each strand = 30·6 kN

6 Handling should be in the vertical position as it is to be finally placed

a = Width of the rafter/ column

DRG. No.144 DETAILS OF 12m SPAN PRESTRESSED CONCRETE (PRETENSIONED) CLADDING RUNNER AND PURLIN



SECTION A-A

(a) For 6m Span Purlin

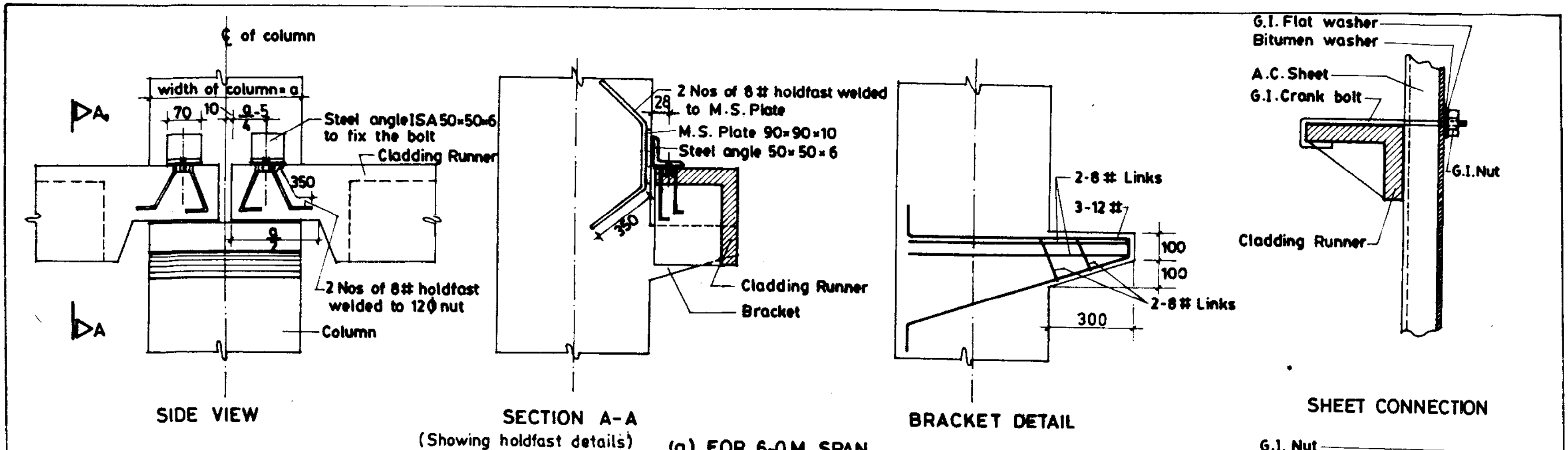
LUG DETAILS

SECTION B-B

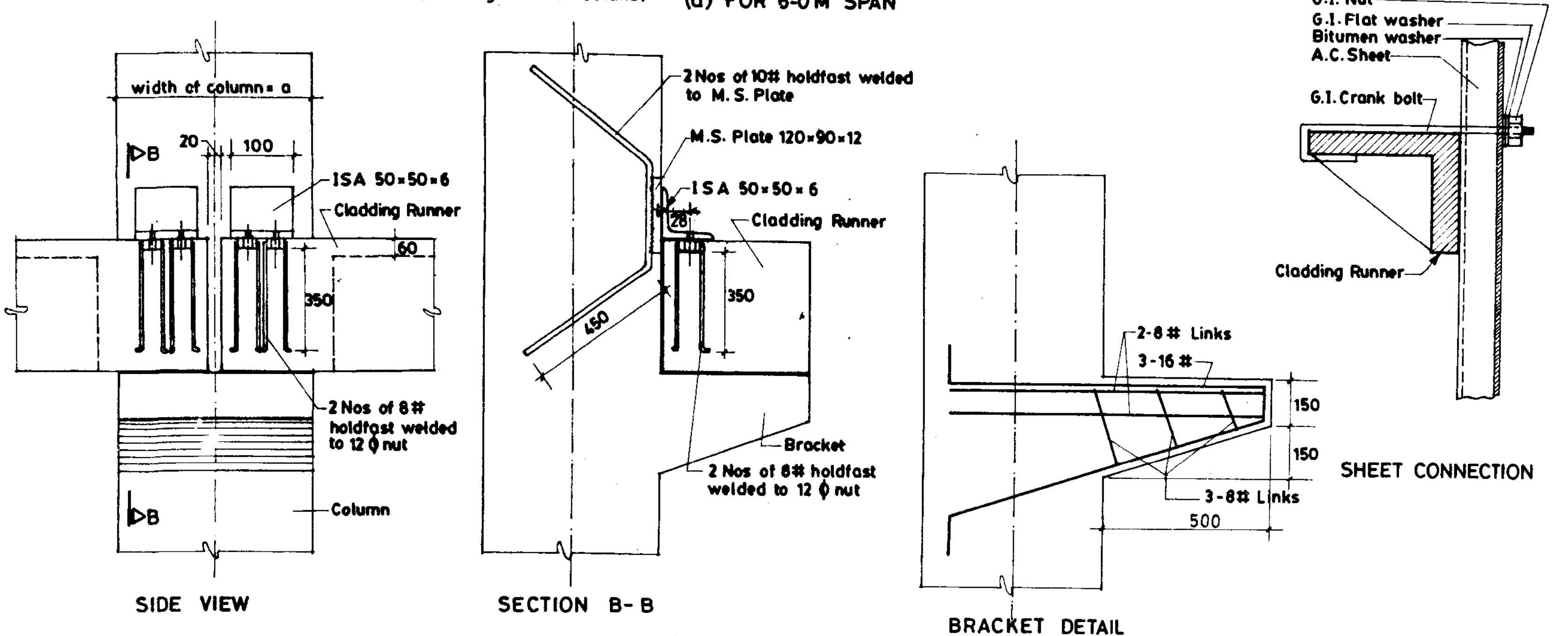
(b) For 12m Span Purlin

LUG DETAILS

DRG No. 145 FIXING DETAILS FOR PURLIN

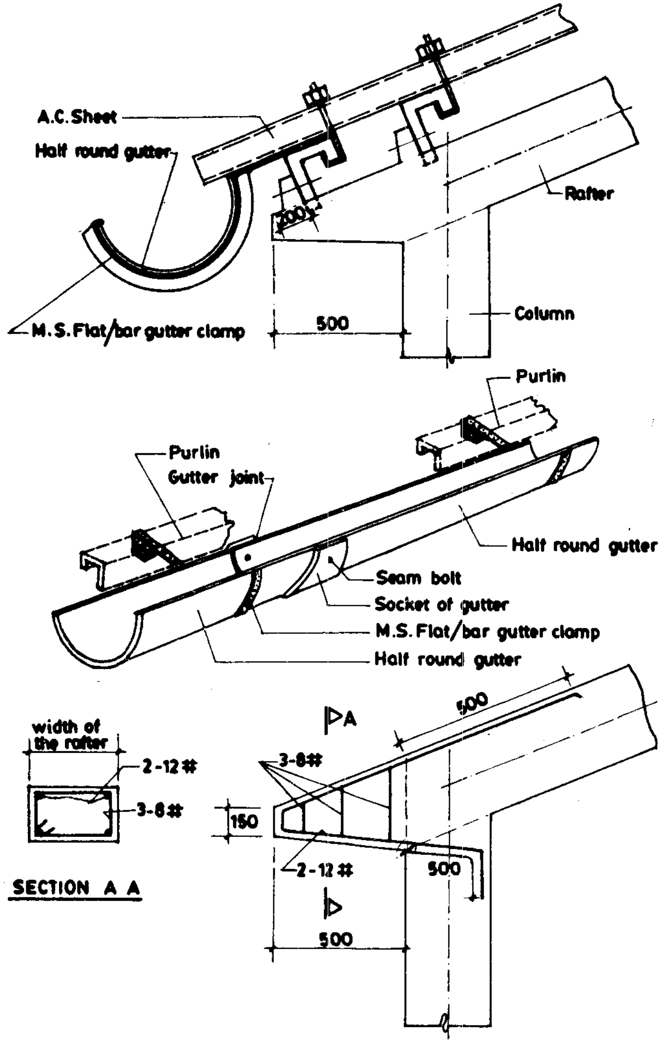


(a) FOR 6-0 M SPAN

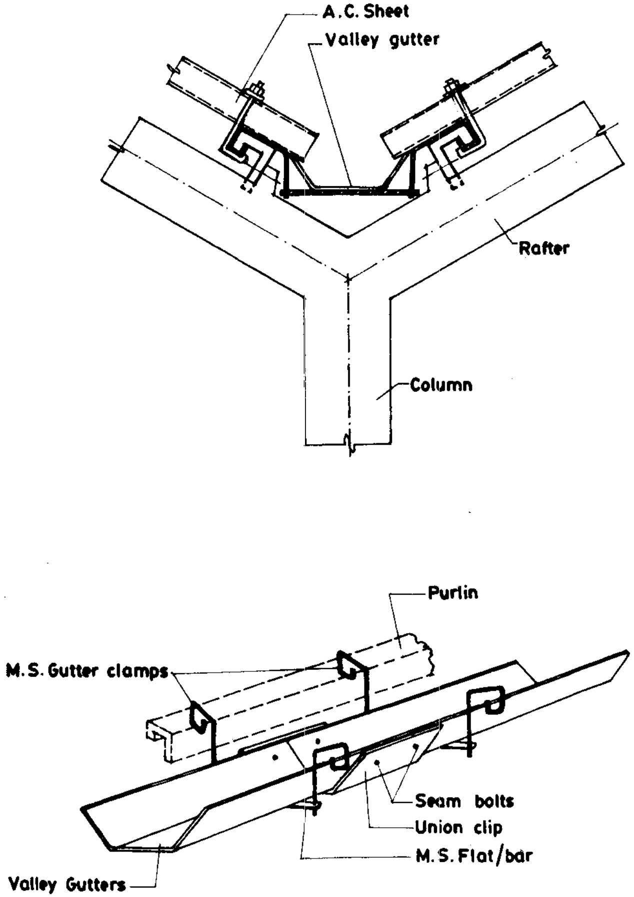


(b) FOR 12-0 M SPAN

DRG. No. 146 FIXING DETAILS OF CLADDING RUNNERS

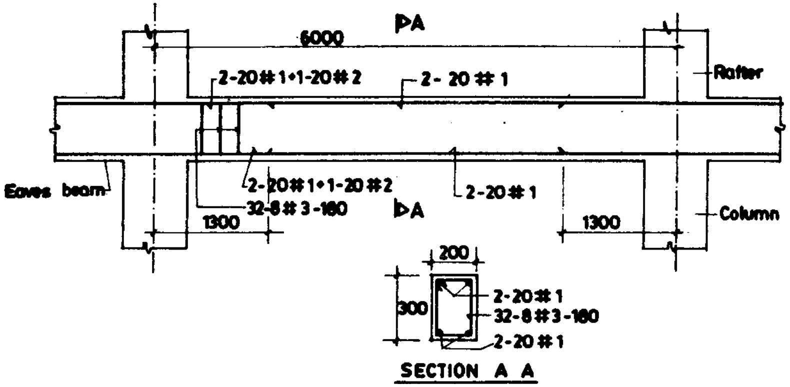


(a) EXTERNAL GUTTER

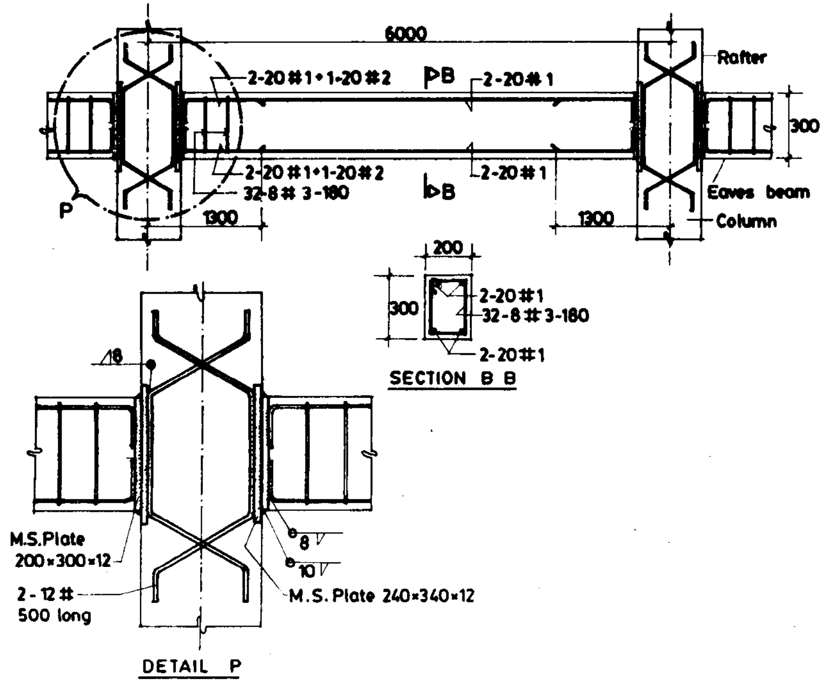


(b) VALLEY GUTTER

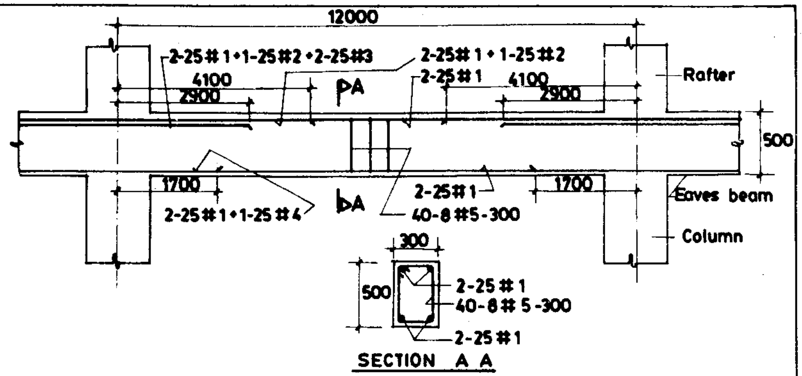
DRG. No. 147 GUTTER DETAILS



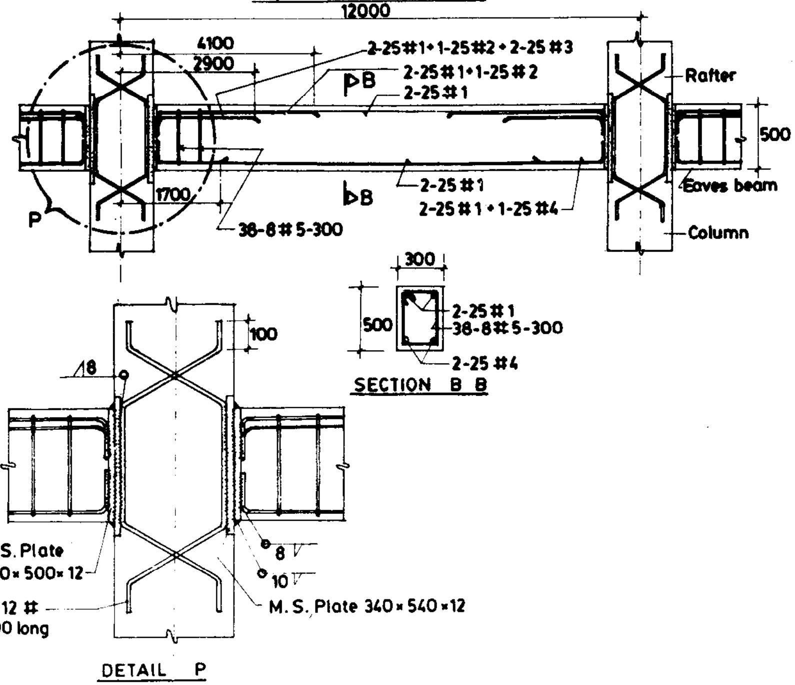
(a) CAST-IN-SITU



(b) PRECAST
(i) FOR 6.0 M SPAN

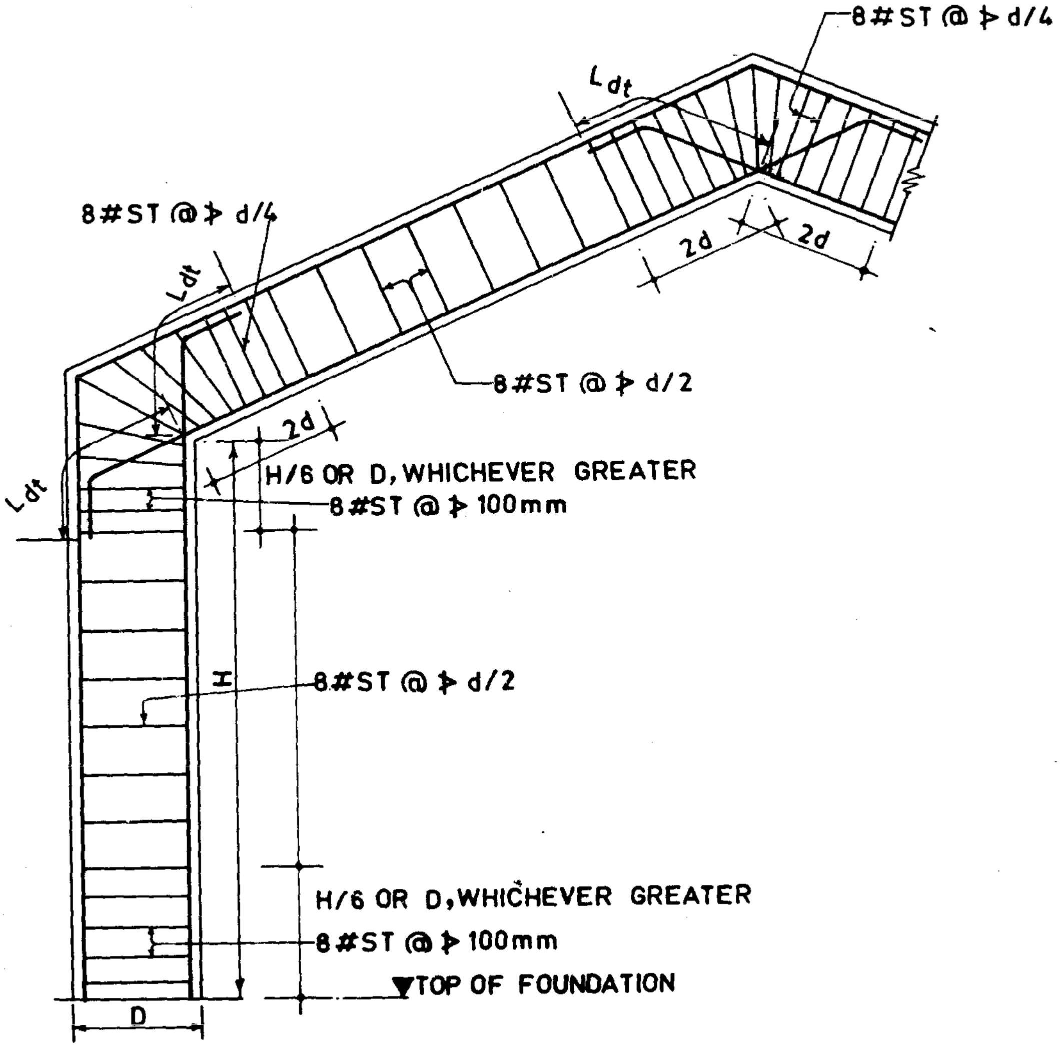


(a) CAST - IN - SITU



(b) PRECAST
(ii) FOR 12.0 M SPAN

DRG. No. 148 DETAILS OF EAVES BEAMS



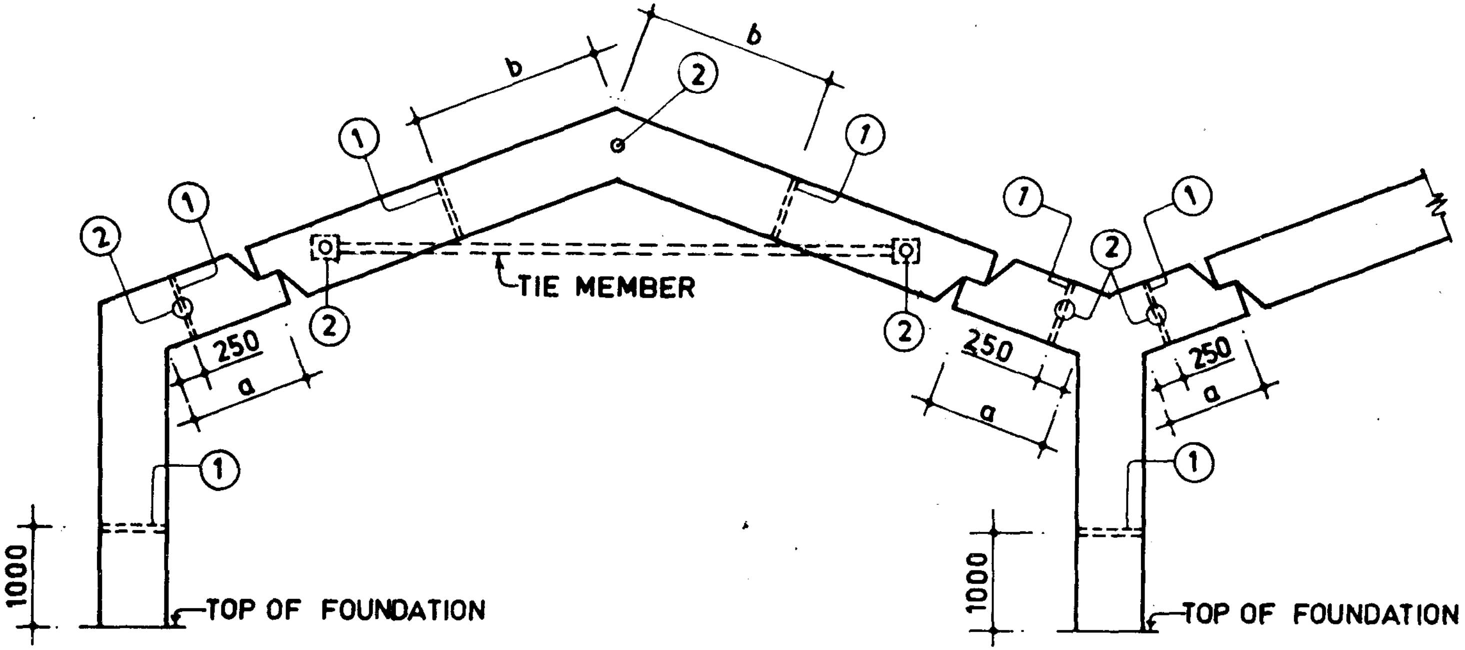
ST = STIRRUPS
d = EFFECTIVE DEPTH OF SECTION
L_{dt} = DEVELOPMENT LENGTH IN TENSION

DRG. No.149 TYPICAL DETAILING FOR DUCTILITY REQUIREMENT

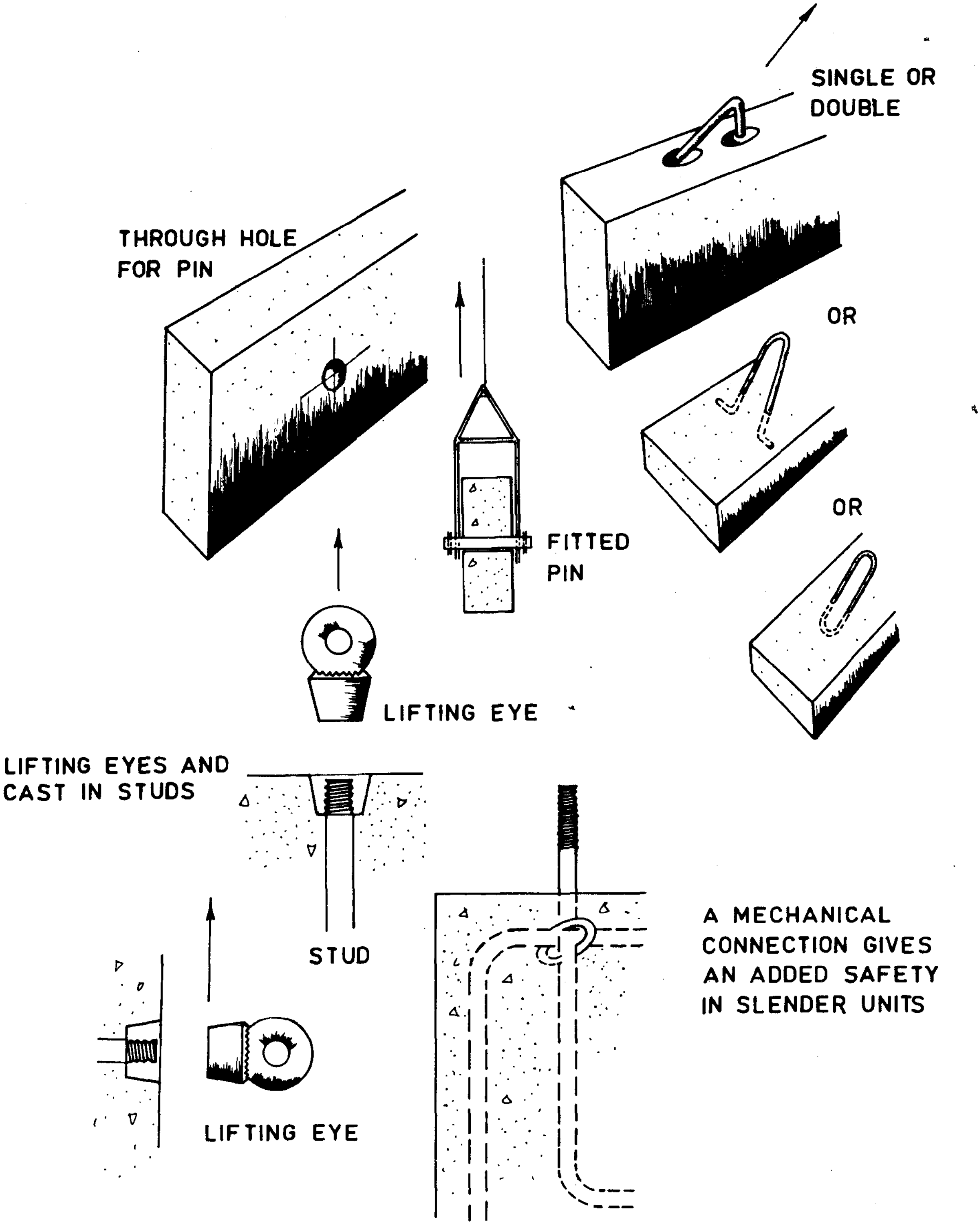
① INDICATES HOLE FOR TRANSPORTATION

② INDICATES HOLE FOR ERECTION

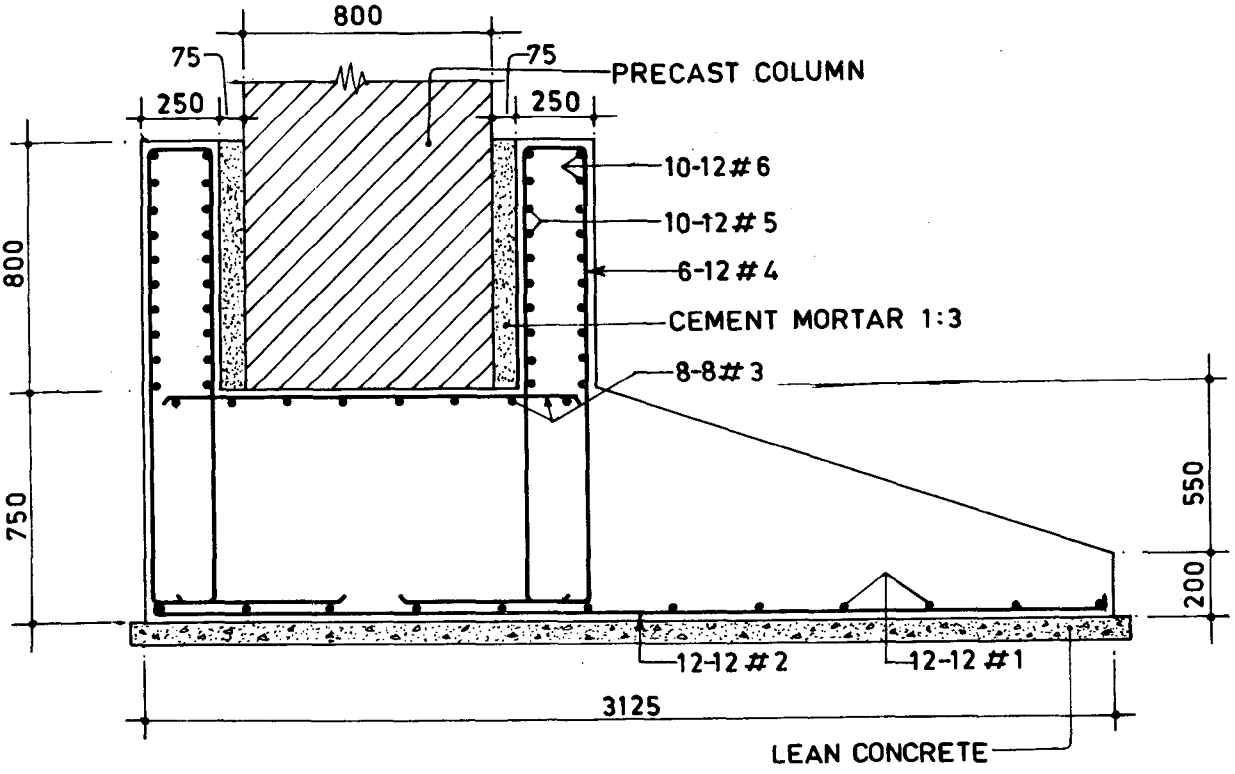
FOR DISTANCES 'a' AND 'b' REFER TABLE NO. 141



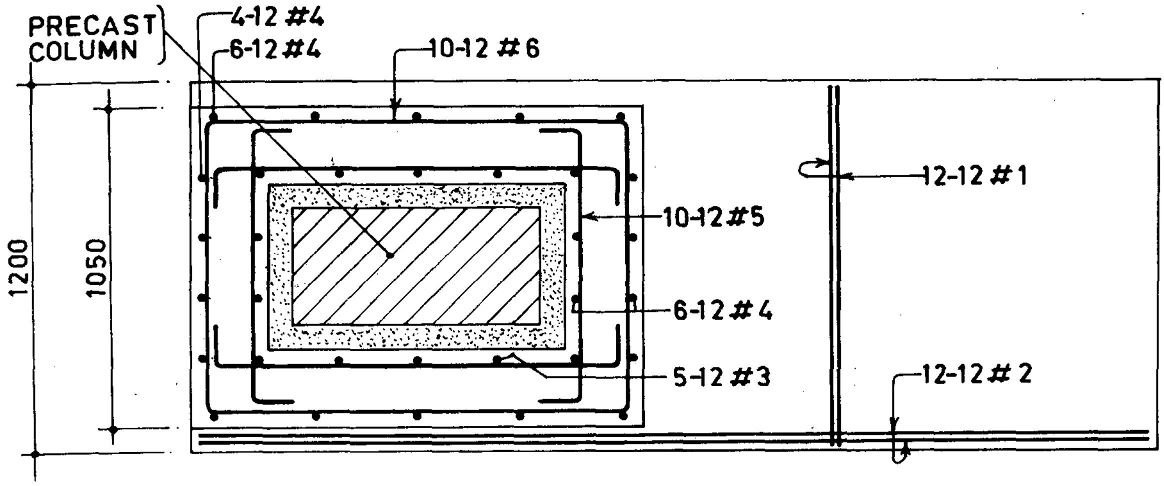
DRG. No. 150 LOCATION OF JOINTS AND LIFTING POINTS DURING TRANSPORTATION AND ERECTION


SINGLE OR DOUBLE
THROUGH HOLE FOR PIN
OR
OR
FITTED PIN
LIFTING EYE
LIFTING EYES AND CAST IN STUDS
STUD
A MECHANICAL CONNECTION GIVES AN ADDED SAFETY IN SLENDER UNITS
LIFTING EYE

DRG. No. 151 SCHEMATIC DETAILS OF FIXTURES FOR HANDLING PRECAST MEMBERS



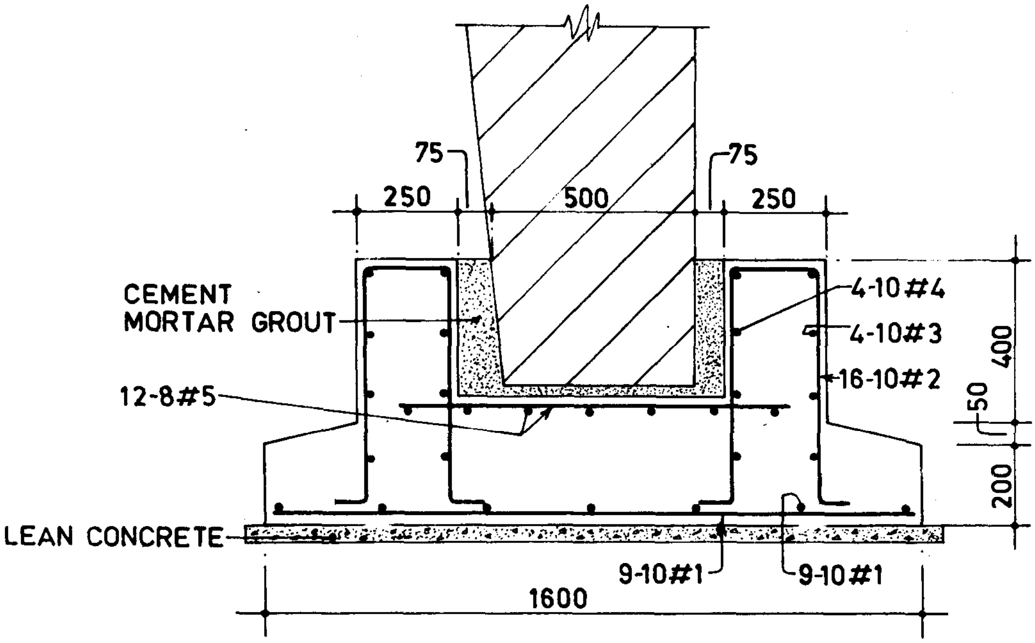
ELEVATION



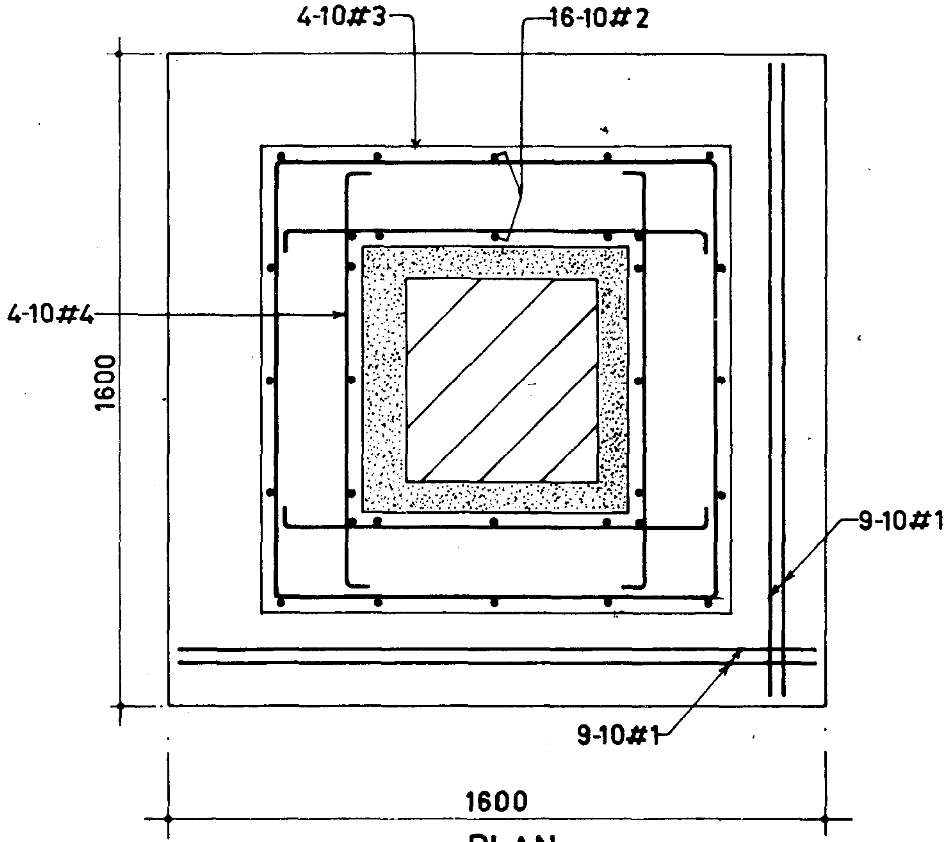
PLAN

a) FIXED BASE

DRG.152 DETAILS FOR PRECAST COLUMN AND CAST-IN-SITU FOUNDATION (CONTD.)



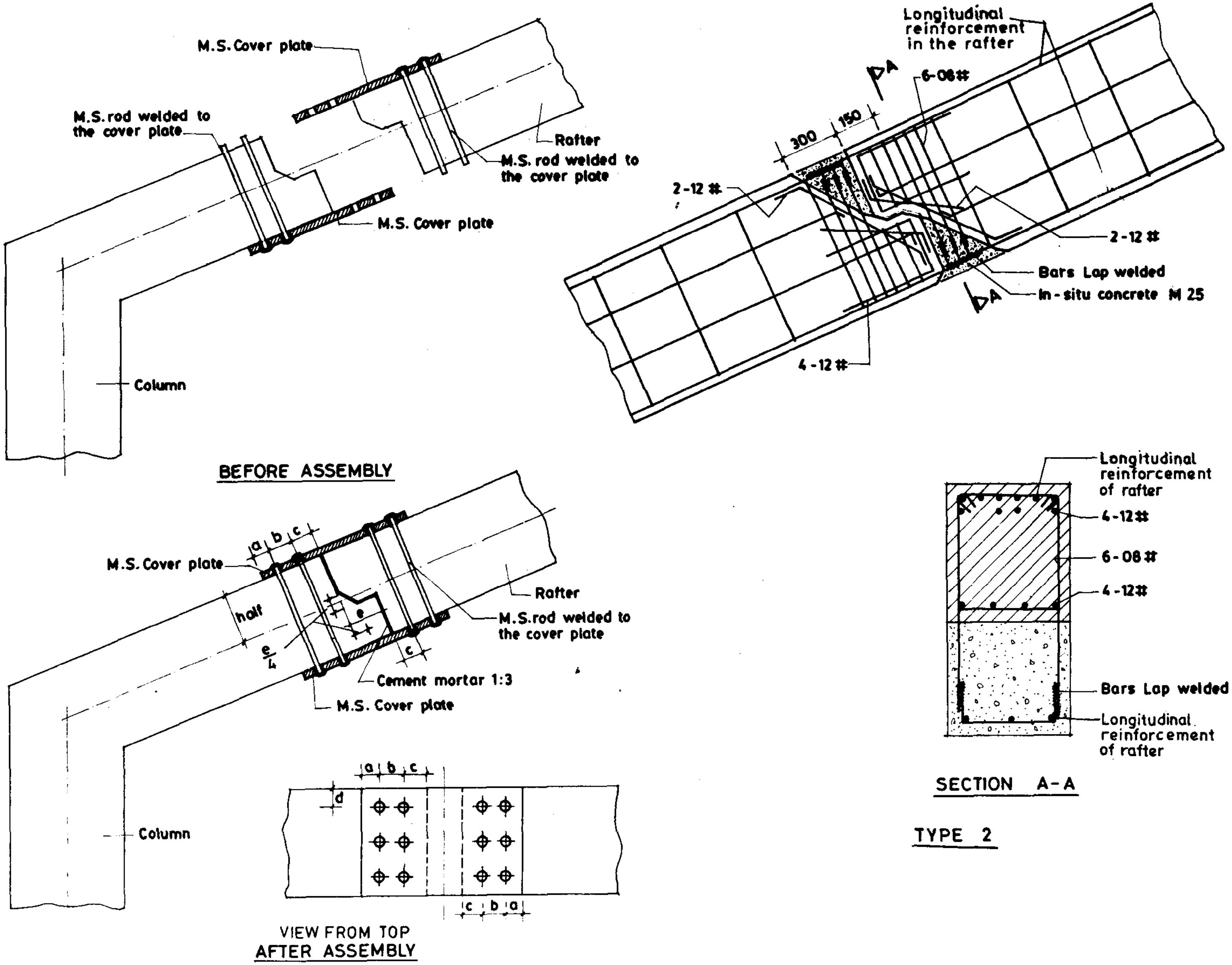
ELEVATION



PLAN

b) HINGED BASE

DRG. 152 DETAILS FOR PRECAST COLUMN AND CAST-IN-SITU FOUNDATION



BEFORE ASSEMBLY

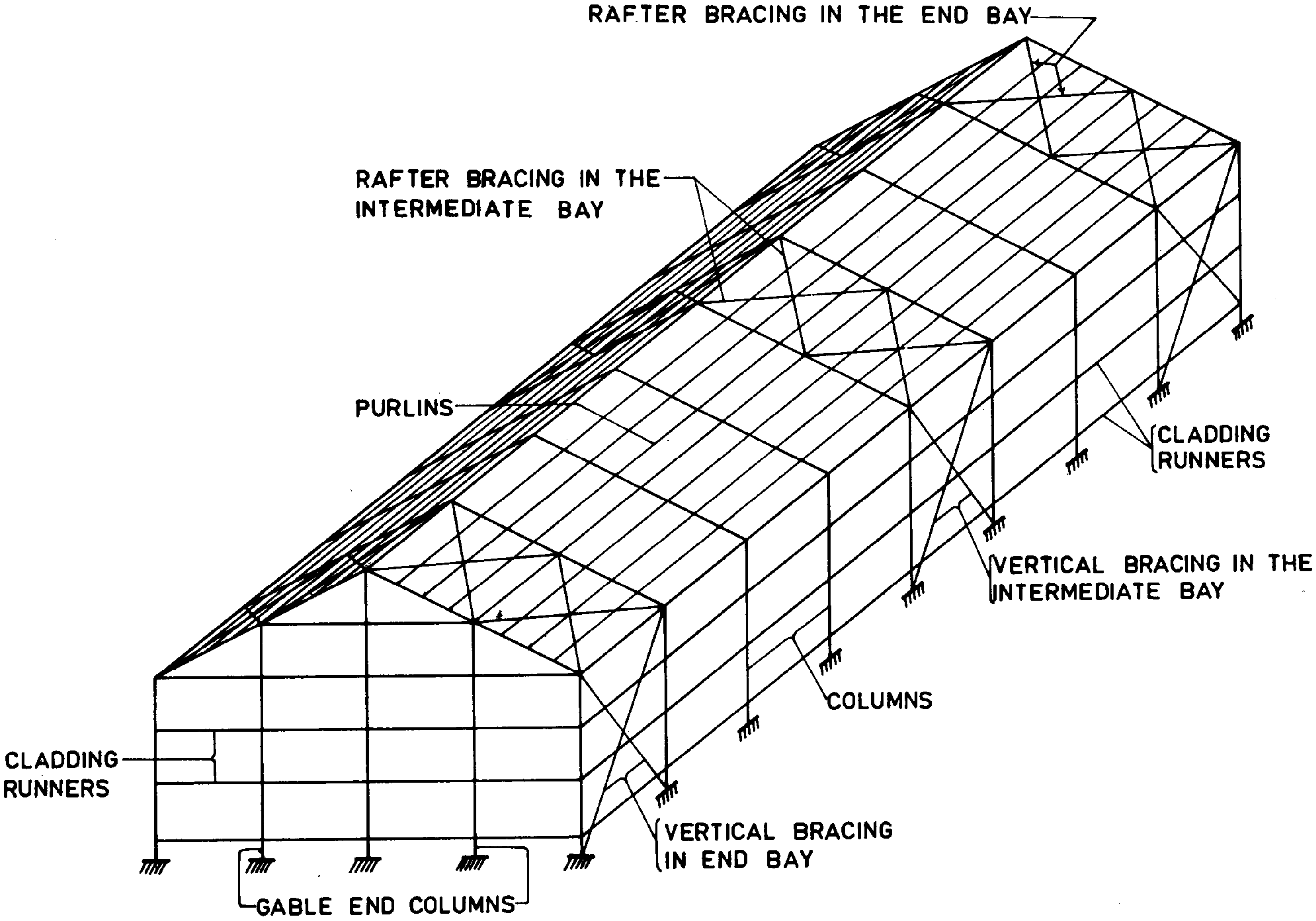
VIEW FROM TOP
AFTER ASSEMBLY

TYPE 1 (Refer Table No. 142)

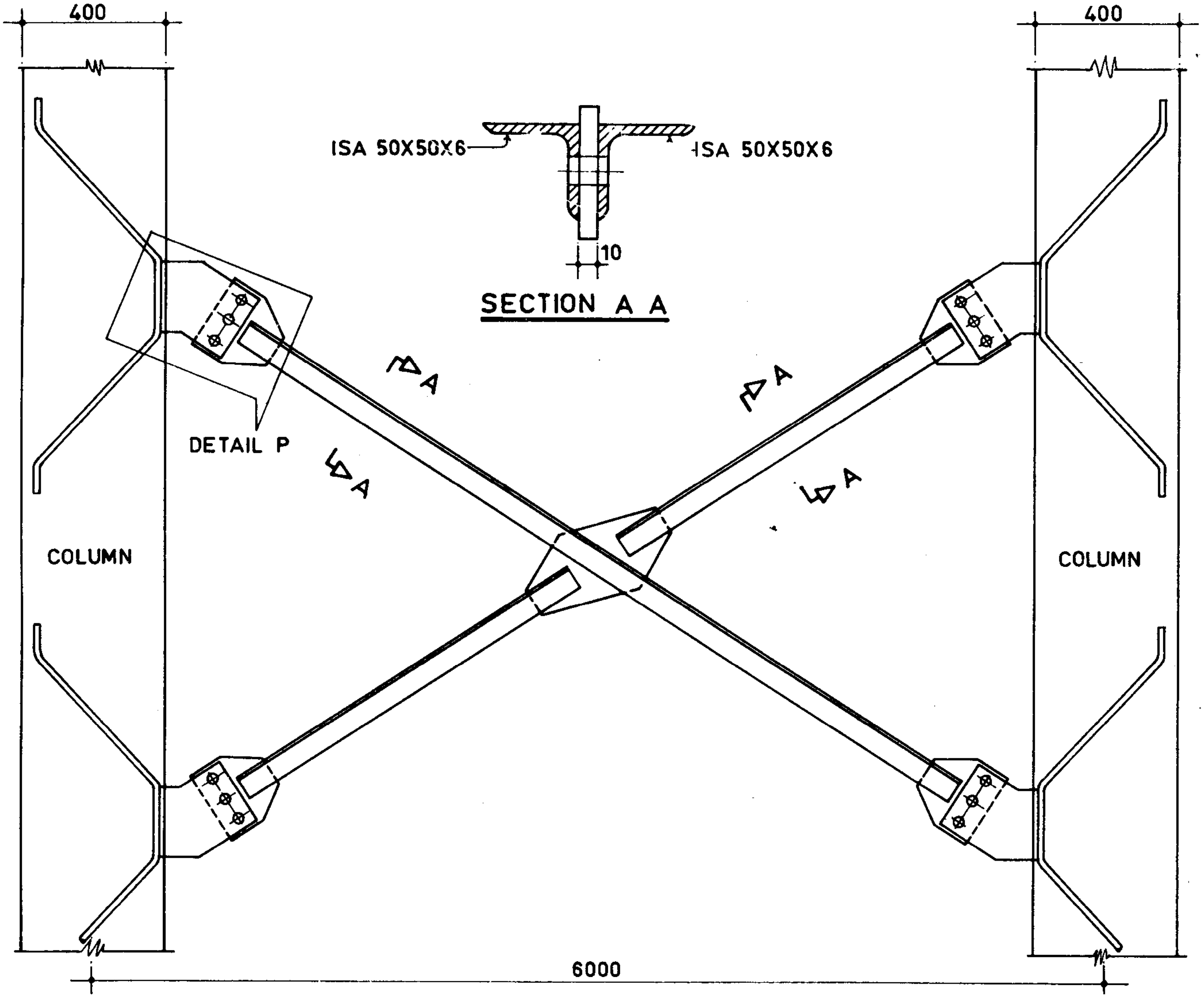
SECTION A-A

TYPE 2

DRG. No. 153 TYPICAL CONNECTION DETAILS IN A RAFTER

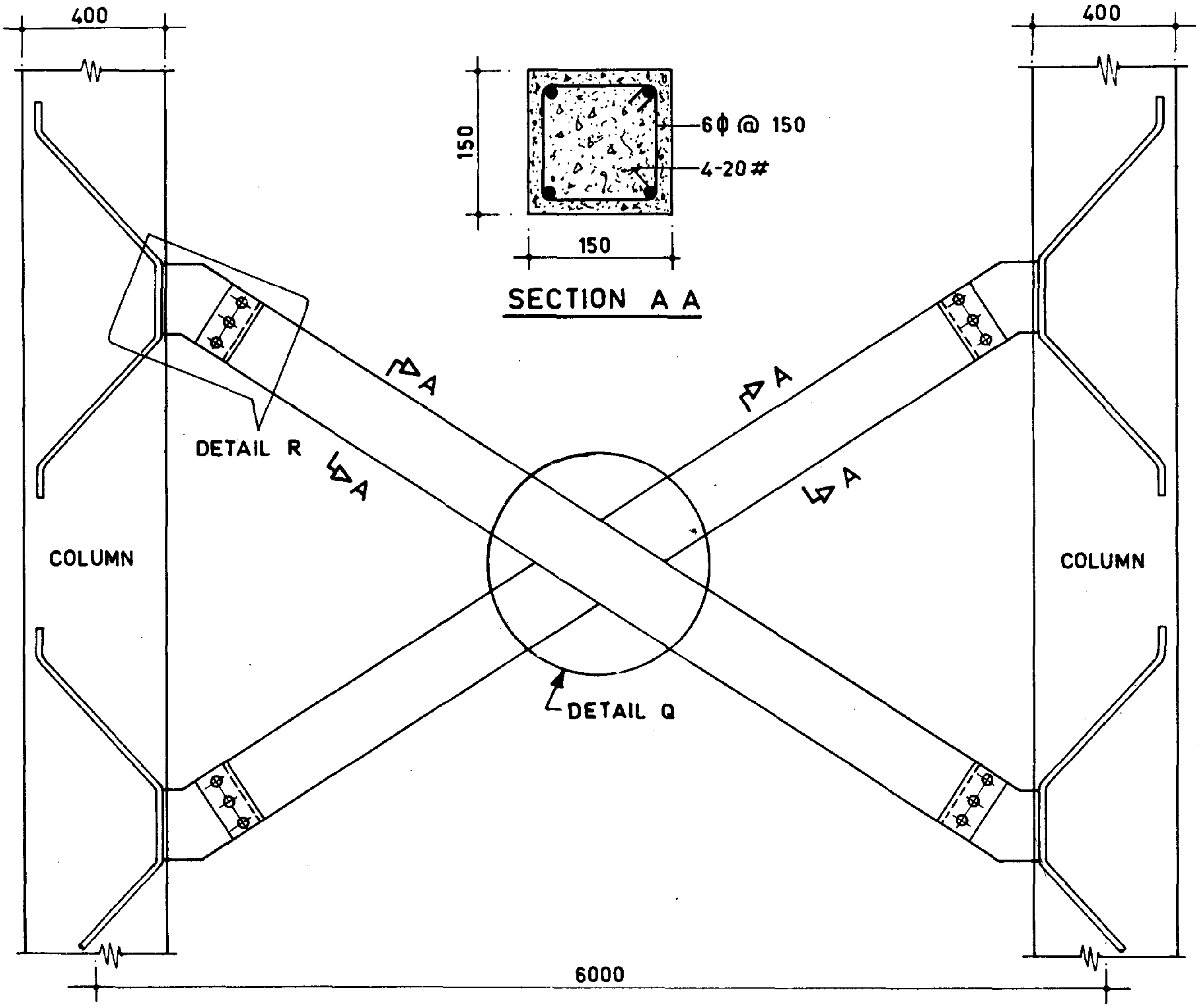

RAFTER BRACING IN THE END BAY
RAFTER BRACING IN THE INTERMEDIATE BAY
PURLINS
CLADDING RUNNERS
VERTICAL BRACING IN THE INTERMEDIATE BAY
COLUMNS
CLADDING RUNNERS
VERTICAL BRACING IN END BAY
GABLE END COLUMNS

DRG. No. 154 SCHEMATIC ARRANGEMENT OF BRACING



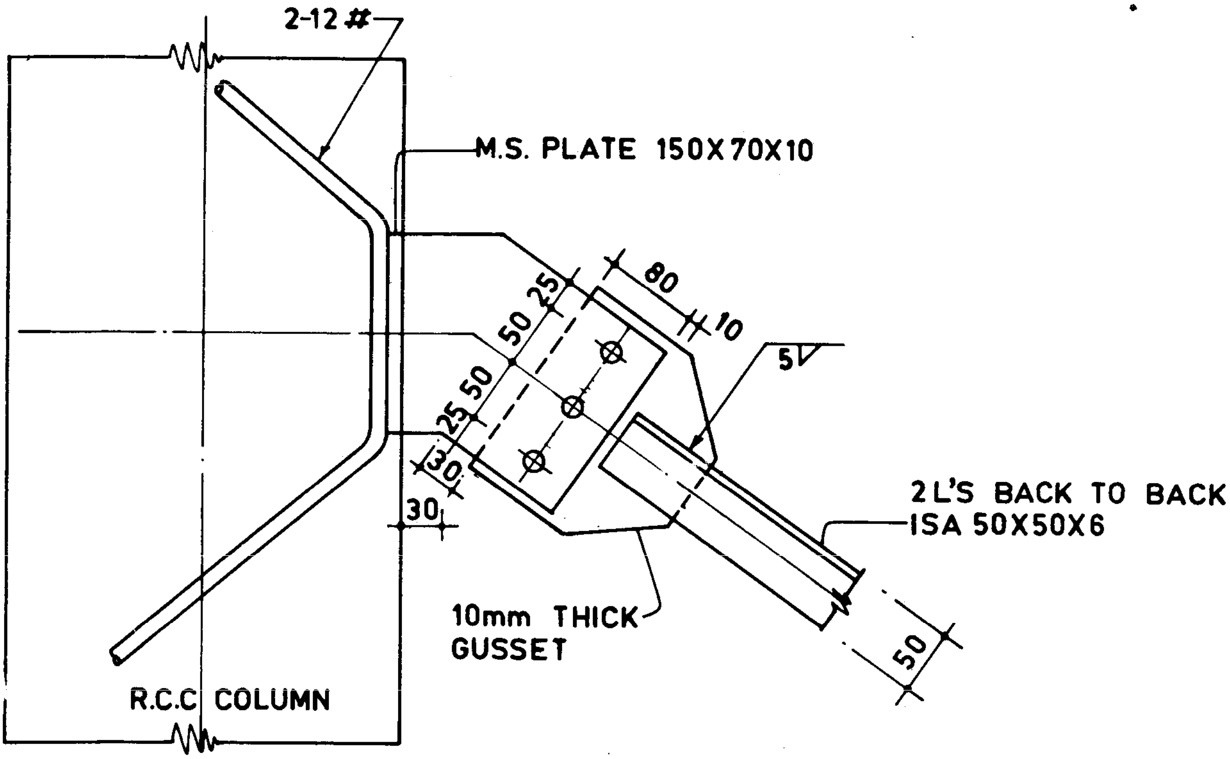
(a) STEEL BRACING

DRG. No.155 DETAILS OF BRACING (CONTD.)

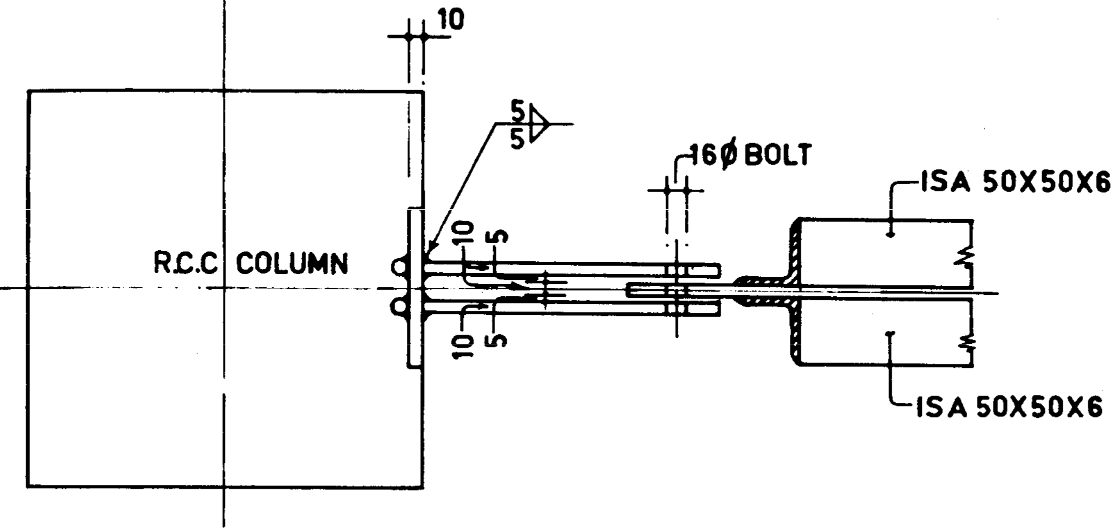


(b) RCC BRACING

FIG. 155 DETAILS OF BRACING (CONTD.)



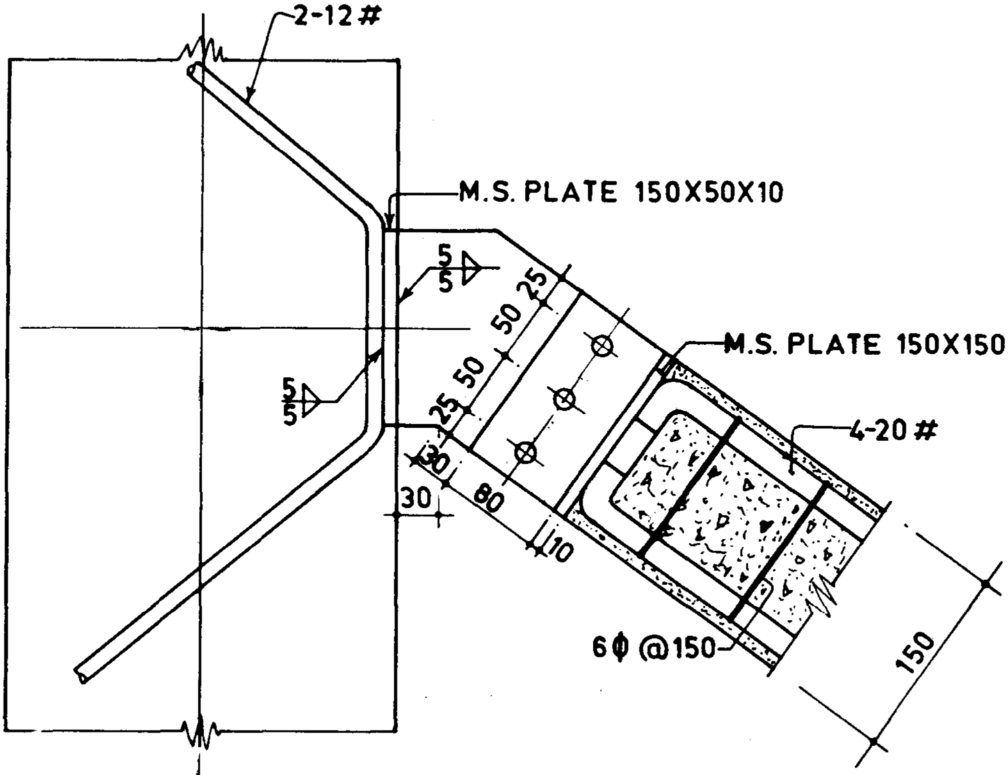
ELEVATION



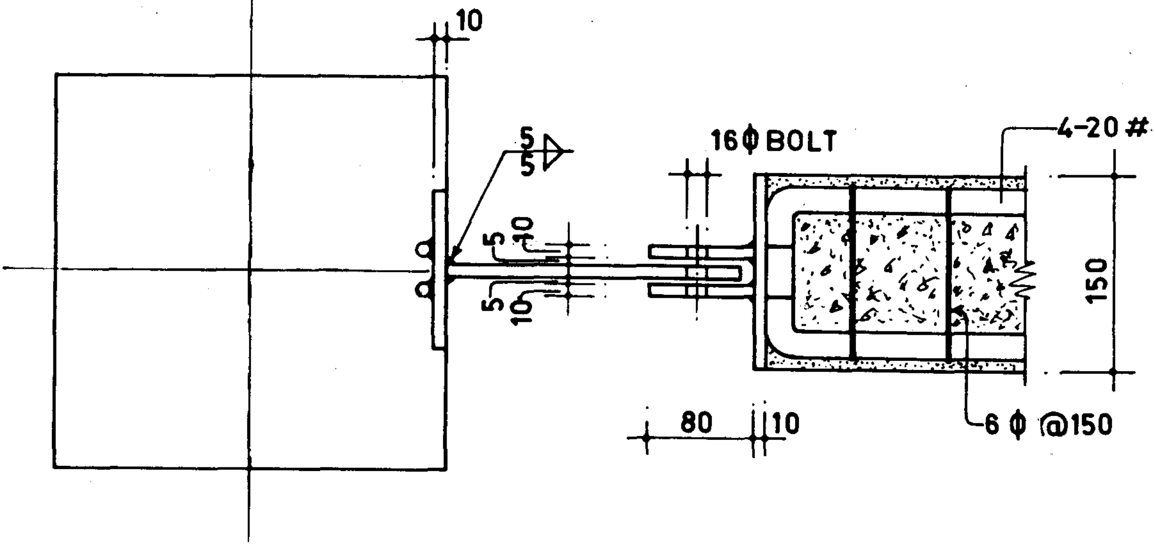
PLAN

DETAIL P

DRG. 155 DETAILS OF BRACING (CONTD.)



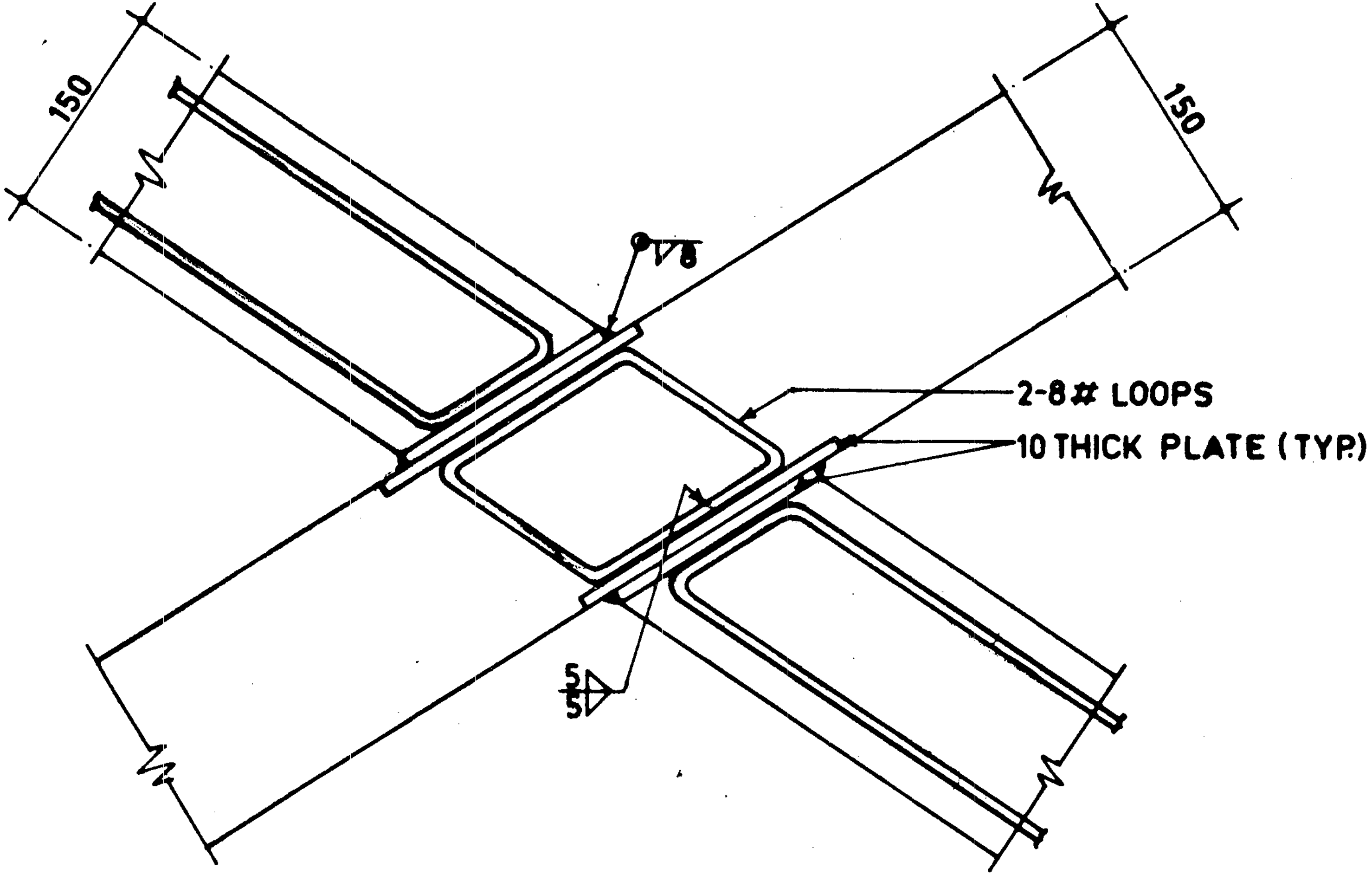
ELEVATION



PLAN

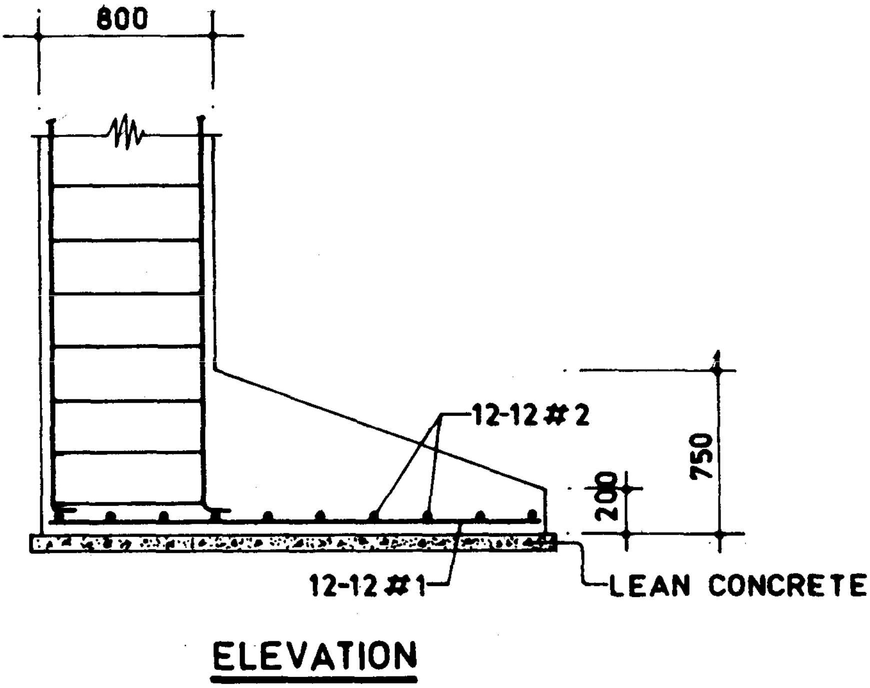
DETAIL R

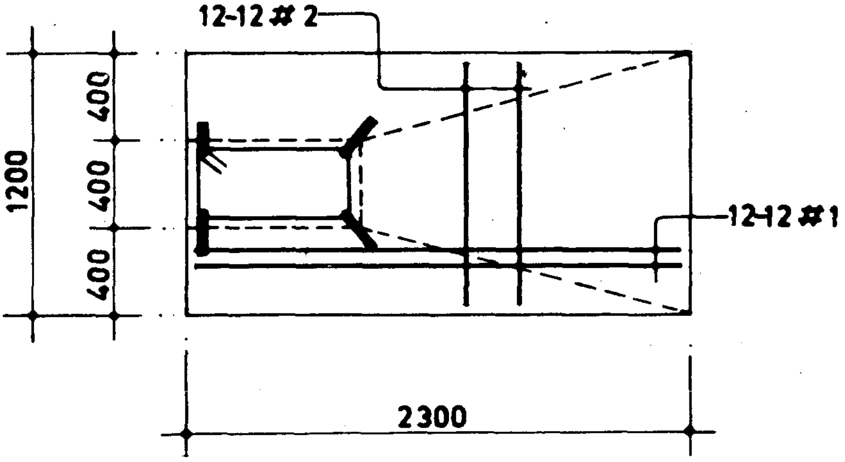
DRG. 155 DETAILS OF BRACING (CONTD.)



DETAIL Q

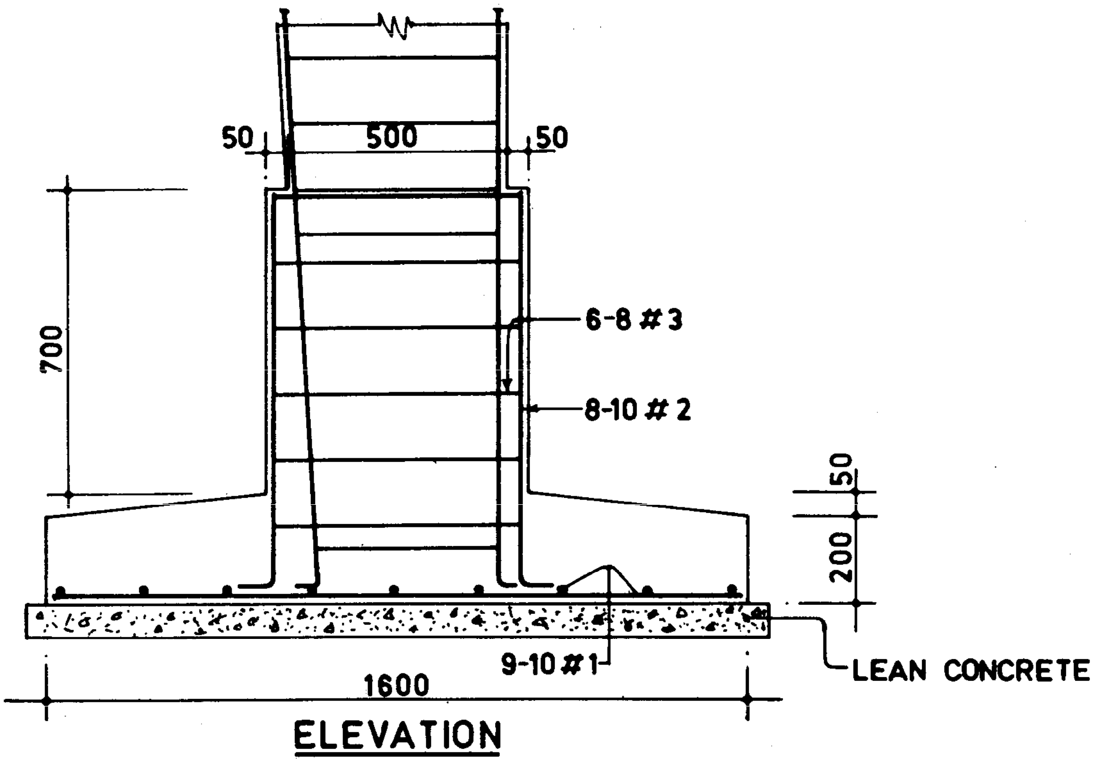
DRG. 155 DETAILS OF BRACING

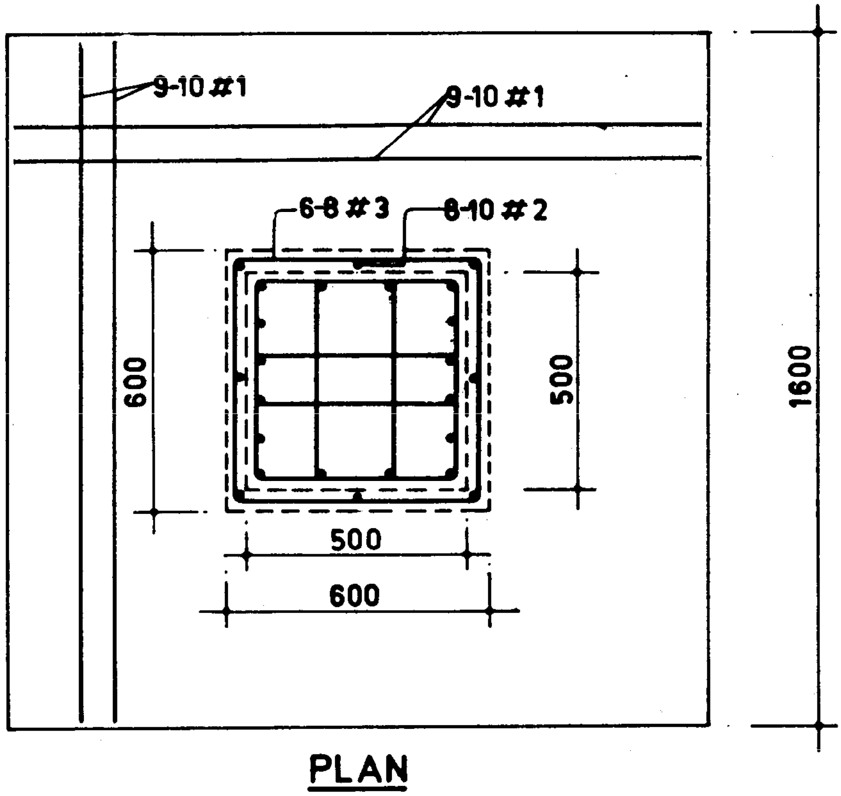




(a) FOR FIXED BASE (FOR DESIGN REFER CLAUSE 6.5.1)

DRG. 156 FOUNDATION DETAILS FOR CAST-IN-SITU COLUMN





(b) FOR HINGED BASE
(FOR DESIGN REFER CLAUSE
6·5·3·1)

DRG. No. 156 FOUNDATION DETAILS FOR CAST-IN-SITU COLUMN